THE WILEY TECHNICAL SERIES

FOR

VOCATIONAL AND INDUSTRIAL SCHOOLS

EDITED BY

JOSEPH M. JAMESON

GIRARD COLLEGE

THE WILEY TECHNICAL SERIES

EDITED BY

JOSEPH M. JAMESON

TEXT BOOKS IN AGRICULTURE

NOW READY

Market Gardening. By F. L. YEAW, Manager, Oasis Farm and Orchard Company, Roswell, N. M. Formerly Professor of Market Gardening, Massachusetts Agricultural College. vi+120 pages, 5 by 7. 36 figures. Cloth, 75 cents net.

Studies of Trees: Their Diseases and Care. By J. J. LEVISON, Department of Parks, Brooklyn, N. Y. 5¼ by 8. x+253 pages, 156 half-tone illustrations. Cloth, $1.60 net. (Also 8 by 10½, loose leaf.)

Agricultural Drafting. By CHARLES B. HOWE, Bushwick Evening High School, Borough of Brooklyn, New York, N. Y. viii+63 pages, 8 by 10¾. 45 figures, 26 plates. Cloth, $1.25 net.

Exercises in Farm Dairying. By Professor C. LARSEN, Department of Dairy Husbandry, South Dakota State College. Loose Leaf. 8 by 10½. 69 Exercises. Complete, Paper cover, $1.00 net.

Field and Laboratory Studies of Soils. By Professor A. G. MCCALL, Department of Agronomy, Ohio State University. viii+77 pages, 5 by 7¼. Cloth, 60 cents net.

Field and Laboratory Studies of Crops. By Professor A. G. MCCALL, Department of Agronomy, Ohio State University. viii+133 pages, 5 by 7¼. 54 figures. Cloth, 85 cents net.

The Chemistry of Farm Practice. By T. E. KEITT, Professor of Soils, Clemson Agricultural College. xii+252 pages, 5¼ by 8, 81 figures. Cloth, $1.25 net.

School Entomology. By DEAN E. D. SANDERSON and Professor L. M. PEAIRS, West Virginia University. vii+356 pages, 5¼ by 8, 233 figures. Cloth, $1.50 net.

For full announcement see list following index.

5000 4-2-17

A corner of the apartment kitchen of the Washington Irving High School

FOOD

ITS COMPOSITION AND PREPARATION

A TEXTBOOK FOR CLASSES IN HOUSEHOLD SCIENCE

BY

MARY T. DOWD

AND

JEAN D. JAMESON

Teachers of Household Science
Washington Irving High School, New York City

FIRST EDITION

NEW YORK
JOHN WILEY & SONS, INC.
LONDON: CHAPMAN & HALL, LIMITED
1918

PRESS OF
BRAUNWORTH & CO.
BOOK MANUFACTURERS
BROOKLYN, N. Y.

PREFACE

In presenting this book for the consideration of the public, the authors are well aware of the present very general practice of furnishing all necessary instructions and theory to Domestic Science classes through the medium of notes taken by the students. Indeed it is to the conviction, resulting from long experience with the problem, of the futility and inefficiency of this practice that the book owes its origin. Much of the time thus spent by the teacher in dictating, and by the student in writing, can and ought to be saved for more profitable use.

It is questionable whether the advantages derived from note taking by elementary classes are as great as popularly supposed; certainly they do not compensate for the amount of valuable experience in the broader applications of the subject that is lost when the time is thus used. Moreover, notes taken hurriedly, as under the conditions of the class room, are often incorrectly copied, and the girl's attention is unfortunately fixed upon the mechanical process of getting down all that the teacher has said, rather than upon the comprehension of *what* has been said.

It is believed by the authors that, if the subject is to be taught with any degree of uniformity throughout a large school or in a city where there are several teachers supposedly presenting the same subject matter, there should be some common material that may be put directly in the hands of the pupils for home study.

The text is an elaboration of the notes dictated by the authors to their own High School classes. It is designed

to supplement the laboratory work and to bring to the pupils a clearer conception of the relation between the cost of foods and their nutritive value.

No recipes are given for the reason that, after close association with many Domestic Science teachers, the conclusion has been reached that each one has her own special recipes and considers no others quite so good. Again, the tendency of the age is to get away from the teaching of hard and fast rules for doing things and to teach, rather, the application of well-defined principles. The general adoption of a card catalogue system for the purpose of filing recipes makes a cook book unnecessary.

No attempt has been made to deal with such matters as setting the table, table service or table etiquette, as it is believed that these can be taught satisfactorily only by actual demonstration and practice. The subject of special diets for invalids and infants is omitted as coming more properly within the scope of a treatise in dietetics.

In studying foodstuffs, it has been the experience of the writers that a consideration of the simple compound water, made up of but two elements, is the natural starting point from which the pupils may be carried by easy stages to a consideration of the more complex compounds.

A vocabulary of the subject has been inserted in the course, as familiarity with the commoner technical terms will be found of great assistance to a clear understanding of the chapters that follow.

Mary T. Dowd.
Jean D. Jameson.

New York.

CONTENTS

CHAPTER XI

CHAPTER XII

CHAPTER XIII

CHAPTER XIV

CHAPTER XV

FOOD

ITS COMPOSITION AND PREPARATION

CHAPTER I

INTRODUCTORY

1. Definition of Food.—Food is any substance which, when taken into the body, is capable of building body substance, yielding energy, or regulating body processes.

2. Classification of Foods.—Foods may be classified as *organic* and *inorganic.* The organic foods, as the name implies, are derived from an organism, which organism may be a plant or an animal. As organic foods serve the purpose of replacing tissues which have been oxidized (burned) they themselves must be oxidizable.

Inorganic foods serve to replace tissue which has not been oxidized; they are water and mineral substances and are not oxidizable.

3. Food as a Source of Energy.—A plant has the power of taking carbon dioxide from the air, and with the aid of the light and heat of the sun, combining it with water from the soil, thus forming such compounds as starch, sugar and protein. Heat is absorbed during the process; therefore, when these compounds are oxidized in the body, they decompose into their original constituents, at the same time liberating the same amount of heat as was absorbed during their formation. This liberated heat is the source of all body energy.

While animals cannot make use of such simple substances as are found in the air and the earth, they can use such substances when they have been transformed by the plant. The animals, in their turn, convert the simple substances into more complex substances which man designates as *animal food*.

4. How Food is Like the Body Tissues.—If food is to build body tissue, it must bear some likeness to that tissue. As this likeness does not lie in appearance it must in composition, and chemical analysis shows this to be the case. Food and the body tissues are made up of similar elements and compounds.

The elements are: Oxygen, hydrogen, nitrogen, carbon, sulphur, phosphorus, chlorine, sodium, potassium, calcium, magnesium, iron, fluorine, silicon, and iodine.

The compounds are: Water, fat, carbohydrates, protein, and mineral matter. These compounds, when spoken of in connection with food, are called *foodstuffs* and must not be confused with *food materials*, such as eggs, meat, cereals, etc.

5. Composition of Foodstuffs.—*Water* is composed of the two elements oxygen and hydrogen.

Fat is composed of the three elements oxygen, hydrogen, and carbon.

Carbohydrates, which include starch and sugar, are composed of the same three elements that form fat, but in the carbohydrates the oxygen and hydrogen occur in the proper proportion to form water.

Water, fat, and carbohydrates are the first of the great foodstuffs which the plant manufactures from the simple inorganic compounds.

Proteins are the most complex of all the foodstuffs. They contain, in addition to the three elements found in fats and carbohydrates, other elements, the chief of which are nitrogen and sulphur. The nitrogen occurs in simpler substances called *amino acids*, and these by different combinations form the various proteins.

Mineral Matter includes such chemical elements as iron, calcium, magnesium, potassium, sodium, chlorine, sulphur, and phosphorus. Some of these occur as elements while others are found only in combination; some occur in organic material while others exist only in their inorganic form.

6. Tests for Foodstuffs.—*Water* may be detected in food by heating a small amount of the food in a test tube. Drops of water will form on the sides of the tube.

Starch may be detected by adding to the food, or a solution of the food, a few drops of iodine. The material will turn blue if starch is present.

Sugar may be detected by boiling a small portion of the food in water and then adding Fehling's solution.* A reddish brown precipitate is formed if sugar is present.

Fat may be detected in the following way: stir some of the food with ether or benzine, allow it to stand ten minutes, then filter it and allow the ether to evaporate. The fat will remain.

Protein may be detected by the use of nitric acid and ammonia. The substance turns yellow if protein is present.

Mineral Matter may be detected by burning a sample of the food. The residue which will not burn is mineral matter.

7. Functions of the Foodstuffs in the Body.—The function of water in the body is to build tissue and regulate body processes.

The chief function of fat is to yield energy, but it may be stored in the body as fatty tissue.

The chief function of carbohydrate is to supply energy to the body, but it may furnish building material also.

The chief function of protein is to build tissue, but it may also furnish energy.

The chief function of mineral matter is to furnish building material and to regulate body processes.

Vitamines are substances essential to growth and nerve activity.

* Fehling's solution is copper sulphate, Rochelle salts, and caustic soda.

8. The Means by which Food is Made Available.—Food, in order to become available to the body, must undergo certain physical and chemical changes. These changes are brought about by such processes as cooking, digestion, absorption, and assimilation.

Cooking is the preparation of food by the aid of heat. Such foods as milk, eggs, and certain fruits and vegetables may be eaten without cooking, but this is possible only because they have previously been subjected to a process similar to cooking. In the cases of the first two the heat coming from the body of the animal really did the cooking, and in the third the heat from the sun during the process of ripening performed the same operation.

9. Purposes of Cooking.—Cooking is necessary for three distinct purposes:

1. To kill micro-organisms.
2. To make the food more digestible.
3. To improve and develop flavor in the food.

10. Processes of Cooking.—The different methods of applying heat to food are known as *processes of cooking*, and are:

1. *Boiling.*—Cooking in boiling water or at a temperature of 212° F.

2. *Broiling.*—Cooking directly over or under a flame.

3. *Pan-broiling.*—Cooking on a very hot frying pan without any fat.

4. *Baking.*—Cooking in a hot oven.

5. *Roasting.*—Cooking in a very hot oven.

6. *Frying.*—Cooking in sufficient hot fat to cover the food.

7. *Sautéing.*—Cooking in a frying pan in a small amount of fat.

8. *Steaming.*—Cooking over steam.
   (*a*) *Dry*, as in a double boiler.
   (*b*) *Moist*, as in a steamer.

9. *Stewing.*—Cooking in water below the boiling-point, 180° F.

10. *Braising* (or pot roasting).—A combination of stewing and baking.

11. *Fricasseeing.*—A combination of stewing and sautéing.

11. Digestion.—Digestion is the process of changing insoluble foods to soluble. This process takes place in that part of the body known as the *alimentary canal*, Fig. 1. This canal measures from twenty to twenty-five feet in length. Into this canal is poured secretions from such organs as the salivary glands, the pancreas, and the liver, all of which aid in the work of digestion.

The parts of the alimentary canal are the mouth, the œsophagus, the stomach, the small intestine, and the large intestine.

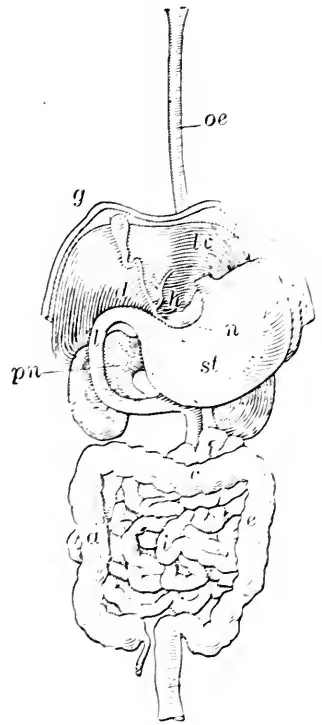


FIG. 1.—Front view of the digestive organs.

a, *c*, *e*, colon;
d, duct of the gall bladder;
g, gall bladder;
i, small intestine;
l, *ι*, liver;
o, *e*, esophagus;
p, *n*, pancreas;
st, stomach.

12. Work of the Alimentary Canal.—Each part of the alimentary canal has its special work to do and is furnished with mechanical and chemical agents for accomplishing its task. The food-stuffs are acted upon chemically in different parts of the canal.

The Mouth.—In the mouth all food is acted upon mechanically by the teeth, which grind it, and by the saliva, which moistens it. The starchy foods are further acted upon chemically by an enzyme called *ptyalin*, which is found in the saliva, and which has the power of changing

the insoluble starch into a form of sugar called *maltose.* From the mouth the food passes through the œsophagus into the stomach.

The Stomach.—In the stomach the food is kept in motion by the muscular walls, which by their churning bring all the food in contact with the *gastric juice.* The connective tissue of meat is here dissolved, and the meat fibres loosened. The walls of fat cells are also dissolved, as well as certain mineral salts such as phosphate of lime. The protein foods are acted upon chemically by two enzymes found in the gastric juice. The first of these, *pepsin,* has the power of changing, in the presence of hydrochloric acid, the non-dialyzable proteins into dialyzable peptones. The second enzyme, *rennin,* coagulates the caseinogen of milk, which is a necessary change before the milk can be digested by the pepsin. It is thought by some that a third enzyme is present in the gastric juice which acts upon emulsified fats.

After the food has remained in the stomach from one to five hours the mass is reduced to a grayish, semi-liquid state in which condition it is known as *chyme,* and begins to pass in small amounts into the small intestine.

The Small Intestine.—Here the food comes in contact with the *pancreatic juice,* an important digestive fluid furnished by the *pancreas;* with the *bile,* a fluid manufactured by the liver; and with the *intestinal juice,* which is secreted by the glands that line the small intestine.

Pancreatic juice contains three enzymes: *trypsin, amylopsin,* and *steapsin* or *lipase.* The trypsin acts upon any proteins which may have escaped the action of the pepsin; the amylopsin acts upon undigested starch, changing it into maltose even more quickly than the ptyalin can; and the lipase serves to emulsify fats and to some extent break them up into fatty acids and glycerin. The action of the bile is to help in the absorption of fats and by its alkalinity to counteract the acidity of the chyme.

The intestinal juice has no special action except upon the

sugars, converting maltose into grape sugar. After the food has been acted upon by the various fluids in the small intestine, it changes from acid chyme into alkaline *chyle*, in which condition much of it is absorbed. Food which is by nature indigestible, or which has been made so by improper cooking, passes from the small intestine into the large.

The Large Intestine.—While the large intestine has no enzyme of its own, the walls furnish a fluid which helps to complete digestive changes which have already begun. Absorption takes place here to some extent and the residue of the food is here evacuated from the body.

13. Absorption.—Much of the digested food is absorbed from the small intestine. All the digested carbohydrate and protein foods are taken up by the epithelial cells, and the fats are taken by the *lacteals* or *lymph vessels*. These are tiny thread-like tubes which convey the fats to the thoracic duct, lying in front of and to one side of the back bone. From there the fats are poured into the blood stream. The other foods are absorbed by the blood capillaries which carry them by the portal system to the liver and thence to the heart to be sent with the blood to nourish all parts of the body.

14. Assimilation.—Assimilation is the process by which each part of the body works over into its own substance material derived from the food eaten.

CHAPTER II

WATER

15. Composition.—In composition water is the simplest of the foodstuffs, as it is made up of but two elements, oxygen and hydrogen.

While water is not capable of yielding energy because it contains no unoxidized hydrogen, its function in the body is of such vital importance that it must be considered most essential.

16. Kinds of Water.—Water is hard or soft, according to the amount of mineral matter present in it. The hardness of some water is due to the presence of lime salts which, if in excess, may interfere with the general health. These salts may be eliminated by boiling the water. This process will drive off the carbon dioxide which holds the carbonates in solution and the lime will be precipitated. Boiling also removes organic impurities. To remove the insipid taste which results from boiling, the water, after having been cooled, may be shaken vigorously.

17. Functions of Water in the Body.—Water serves as building material, two-thirds of the body weight being made up of water. It gives firmness and elasticity to the tissues and constitutes four-fifths of the blood.

Water acts as a great solvent in the body, carries nutriment to all the tissues, and conveys the effete matter to the organs through which it is eliminated. It also keeps the fluids of the body in their liquid state.

Water acts as a body regulating substance and a stimulant; particularly is it important in the digestive tract where experiment has shown that the production of hydro-

chloric acid in the stomach is greatly accelerated after drinking a glass of water. There is proof also that water aids digestion by acting as a diluent on certain digestive juices, thereby increasing their solvent power.

18. Amount of Water Required.—The amount of water which the body requires varies and is dependent upon the surrounding temperature, the amount of muscular activity indulged in, and the nature of the food eaten.

One of the most prevalent dietary errors is the use of too little water in the diet. The daily requirement is approximately four pints. About one-fourth this amount is obtained from the food eaten.

19. Water in Food.—All foods, no matter how dry they may appear to be, contain some water, and some vegetables, such as asparagus, contain as high as 94 per cent of water. The keeping quality of all foods depends largely upon the amount of water they contain. Foods containing more than 20 per cent of water cannot be stored, owing to their tendency to mold. Flour or cereals that are to be kept any length of time must not contain higher than 10 to 12 per cent of water.

TABLE I.—FOODS HAVING A HIGH WATER CONTENT

Weight in ounces of the 100-calorie portion

Watermelon	28¼ ozs.
Cucumbers	20¼ ozs.
Celery	19 ozs.
Lettuce	18½ ozs.
Muskmelon	18 ozs.
Asparagus	16 ozs.
Rhubarb	15¼ ozs.
Tomatoes	14½ ozs.
Egg plant	14¼ ozs.
Spinach	14¾ ozs.
Radishes	12 ozs.
Peaches	10½ ozs.
Cabbage	11¼ ozs.
Buttermilk	9¾ ozs.

20. Water as a Cooking Medium.—Water is necessary in the preparation of food and for this purpose soft water is preferable.

All foods are not cooked at the same temperature, and the degree of heat must be adapted to the food in question. If water is raised slowly to the boiling-point, the following changes will be observed. Tiny bubbles will appear on the bottom and sides of the vessel but will break before reaching the surface. These bubbles are caused by the air and gases which have been confined in the water being driven off by the heat (it is the loss of these which causes the flat taste of boiled water). As the temperature rises, the bubbles in the water will become larger and more nearly spherical and will reach the surface before they break. At this point the water is said to boil, and a thermometer introduced into it will register 212° F. or 100° C.; for an open vessel at sea level, no matter how rapidly the water may boil, the temperature, under ordinary conditions, will rise no higher, the surplus heat being used to convert the water into steam.

21. Raising the Boiling-point.—The boiling-point of water may be raised: (1) By increasing the pressure—for example boiling in a confined space, as in a steam boiler under a pressure of five pounds of steam, when the water will not boil until it reaches 227° F.

(2) By increasing the density—for example a very strong salt solution will not boil until it reaches 226° F., and a sugar solution may have a boiling-point between 215° and 350° F.

22. Lowering the Boiling-point.—The boiling-point of water is lower than 212° F. when the pressure of the atmosphere is less than fifteen pounds to the square inch. In high altitudes, as in Denver, Colorado, water boils at a temperature of 202° F., and on some points in the Himalaya Mountains it boils at a temperature as low as 180° F. Under such conditions it is difficult to properly cook foods which require a high temperature.

EXPERIMENTS

Experiment 1. To Show the Effect of Boiling on Hard Water.—Half fill a beaker with lime water. Blow through a glass tube into the water until it loses its cloudy appearance and becomes clear. (This shows that excess of carbon dioxide keeps lime in solution.) Boil this water and notice the deposit of carbonate of lime on the bottom and sides of the beaker. Add a little acid to this deposit and observe the effervescence that takes place.

Half fill an evaporating dish with water from the faucet. Let it evaporate over a Bunsen burner, and test the residue as in the above experiment.

Experiment 2. To Show Effect of Density on the Boiling-point of Water.—(*a*) Boil water, taking the temperature.

(*b*) Boil a saturated salt solution and take the temperature.

Experiment 3. To Show the Rapidity of Evaporation.—Put the same amount of water in each of two vessels; one deep and exposing but little surface, the other shallow and exposing a large surface. Boil both slowly and observe in which vessel the water boils away first.

CHAPTER III

CARBOHYDRATE IN THE FORM OF SUGAR

23. Composition.—Carbohydrate foodstuffs are a combination of the three elements, carbon, hydrogen, and oxygen. The hydrogen and oxygen are present in the common foods of this class in the proportion to form water.

For purposes of more thorough study, the carbohydrates are sometimes divided into three main groups according to their molecular weight.

Group 1. *Monosaccharides.*—These comprise simple sugars which cannot be split into other sugars of the same or simpler form. They are: *glucose, fructose,* and *galactose.*

Group 2. *Disaccharides.*—These comprise the complex sugars which may be split into two simple sugars. They include: *sucrose, maltose,* and *lactose.*

Group 3. *Polysaccharides.*—These are substances which yield an unknown number of simple sugars. Included in the group are: *starch, dextrin,* and *glycogen.*

24. Monosaccharides.—Monosaccharides are soluble crystalline substances which are absorbed into the blood stream without further change.

The members of this group have the common formula of $C_6H_{12}O_6$. The source and distinguishing characteristics of each of the simple sugars will be considered in turn.

Glucose, sometimes called dextrose, is the most important of the simple sugars as it is in this form that sugar appears in the blood. Normal blood contains about 0.1 per cent of glucose which is being burned continually to produce body energy. Any surplus of glucose absorbed from the digestive tract is stored in the body as glycogen, which is

in turn reconverted into glucose to be burned as needed for energy.

Fructose, or levulose, like glucose, is found as such in some plants and vegetables and in large quantities in honey.

Galactose is of considerable importance in nutrition since it is a product of the digestion of milk. It is utilized in the formation of glycogen in the liver.

25. Disaccharides.—The disaccharides are complex sugars having a formula of $C_{12}H_{22}O_{11}$. They are soluble substances and are changed to simple sugars in the process of digestion.

Sucrose, or *cane sugar,* is found in nature in the juices of certain plants. Sugar cane and the sugar beet yield large quantities of sucrose and form the chief sources of the commercial sugars.

Maltose is formed from starch by the action of acids and enzymes. Maltose also occurs in malt and malt extracts.

Lactose, or *sugar of milk*, is found in the milk of mammals. It is obtained for commercial use from the whey of milk after the curd has been removed in the making of cheese. Lactose is not easily fermented and is, therefore, used in modifying cow's milk for infants.

26. Polysaccharides.—Polysaccharides are complex substances. They are considered at length in Chapter IV.

27. Functions of Sugar in Nutrition.—(1) *As a Source of Energy.* The chief function of sugar in nutrition is to supply energy to the body. It is especially well adapted for use as an energy producer because it is ready for almost immediate absorption into the blood stream. Theoretically, sugar is not essential in a modern dietary where starches are used, since all starches are changed to sugar in the process of digestion. It is recommended that sugar be used in small amounts for flavoring and to give variety to the diet rather than as a source of energy.

(2) *As a building material.* Sugar, in the form of galac-

tose, is found in the growth stimulating part of the nerve cells. An excess of sugar in the system is converted into fat and stored in the body substances.

(3) *As a body regulating substance.* Without carbohydrate, fat cannot burn normally in the body. In other words, fat must burn in a flame of carbohydrate. Unless the calories furnished by carbohydrate exceed those furnished by fat, an abnormal condition of nutrition known as *acidosis* is liable to obtain. This condition is caused by the presence of acid in the body substances rather than in the blood.

28. Digestion of Sugar.—There is no ferment or digestive juice in the body that acts upon the monosaccharides, glucose, fructose, and galactose. These substances are absorbed from the intestines without further change, and pass into the portal vein by which they are carried to the liver. Some of this sugar is changed to glycogen and stored in the liver, and the rest is passed on through the blood stream to the tissues, where it is burned to CO_2 and H_2O to yield energy for work, or is stored in the muscular tissue as glycogen or fat.

In the case of the complex sugars or disaccharides, there is no digestive action in the mouth or in the stomach, but the intestinal membrane secretes a substance known as *succus entericus*, or intestinal juice, containing the three enzymes, *sucrase*, *maltase*, and *lactase*, which act in turn upon the disaccharides and change these double sugars into two single sugars as follows:

Sucrose + sucrase = glucose and fructose.
Maltose + maltase = glucose and glucose.
Lactose + lactase = glucose and galactose.

The processes of absorption and assimilation as glucose, fructose, and galactose go on with but little tax on the digestive organs.

The polysaccharides are taken through a much more complicated process of digestion, but finally reach the same

end and serve the same purpose in the general scheme of nutrition. The digestion of starch probably continues for a time in the stomach, or until the reaction of the contents has become acid, and then ceases until the small intestine is reached. Here is found another enzyme, secreted by the pancreas and known as *amylopsin*, which completes the change of all starch not already taken care of by the ptyalin in the mouth to maltose, a double sugar.

29. Commercial Sugar.—The commercial forms in which sugar may be obtained are more or less familiar to all. Cut sugar is undoubtedly the purest form in which cane sugar may be purchased. Granulated sugar is the most desirable for general use. There is very little difference chemically between sugar made from sugar cane and that made from the sugar beet, but many housewives prefer the cane sugar for cake and candy making.

30. Molasses.—Molasses is the liquid left after the sugar crystals are removed in the manufacture of sugar. It contains a considerable quantity of sucrose and many of the other constituents of the sugar cane juice.

The adoption of modern methods in the making of sugar has had a tendency to increase the amount of sucrose removed by crystallization and to decrease the amount of molasses remaining, as well as to lower its sugar content. The molasses of the present time is inferior in sweetening power and in other characteristics to that formerly produced.

31. Maple Sugar and Syrup.—By evaporating the sap of the sugar maple until more than half of the water has been removed and the product is of proper consistency, maple sugar and maple syrup are obtained. Maple syrup is highly prized for table use. The unadulterated article is expensive and difficult to obtain. It is not uncommon to find maple syrup adulterated with a solution of refined cane sugar, since the latter is less expensive than the pure maple sugar.

32. Honey.—Pure honey consists of a mixture of cane,

grape, and fruit sugars, collected from the flowers and modified by the bees.

In addition to sugar and water, honey contains a very slight amount of protein, 1 per cent of mineral matter, and certain volatile oils to which are due the peculiar odor and flavor. The differences in color and flavor are attributed to the characteristic nectars in the different flowers upon which the bees feed. Clover honey is considered far superior to the dark colored and strong flavored article commonly supposed to be made from buckwheat blossoms.

Honey, as has been stated, contains more fructose than glucose and is therefore more readily absorbed into the blood stream than cane sugar. It is also less liable to cause digestive disturbances due to fermentation. One cup of honey is equal to one cup of cane sugar in sweetening power and may be used in place of sugar. Honey is also a substitute for molasses and may be used in any way that molasses is used. It must be remembered, however, in using honey that the acidity of honey is about one half that of molasses and only one-fourth teaspoonful of soda is required to one cupful of honey to neutralize the acid. Like maple syrup, strained honey is easily adulterated with sugar syrups.

33. Effects of Cooking Sugar.—The boiling of cane sugar and water together, called the hydrolysis of sugar, changes it into equal parts of glucose and fructose.

Cane sugar, when cooked for a long time with acid fruits, is converted into grape sugar or glucose and thereby loses about one third of its sweetening power. This is the reason why the sugar should be added to jams, jellies, and sauces made from acid fruits when the cooking process is nearly completed.

Cane sugar cooked alone is changed first to barley sugar, then to caramel, and finally to carbon. When the sugar is melted and changed to a light brown color, it has made the first change and is known as *barley sugar*. As the

melted sugar is heated to a temperature of 350° F. this brown liquid is converted into a non-crystallizable fluid having a slightly bitter but pleasant taste, which indicates that it has reached the *caramel* stage. This caramel is used as a flavoring substance for creams and sauces and to give color to soup stock. Because of its mildness caramel is frequently recommended as a desirable flavoring in invalid cookery.

Carbon, which is the next step after caramel, is the final stage in the cooking of sugar. It is the burned product.

Table II will be found a valuable aid in the preparation of icings and caramel and in candy making when a chemical thermometer is used.

TABLE II

Stages in Cooking Sugar

Small thread	215° F.
Large thread	217° F.
Pearl	220° F.
Blow	230° F.
Feather	232° F.
Soft ball	238° F.
Hard ball	248° F.
Crack	310° F.
Caramel	350° F.

EXPERIMENTS

Experiment 1.—Compare cane sugar and glucose as to: *(a)* structure; *(b)* solubility; *(c)* taste.

Experiment 2.—Test different kinds of sugar with Fehling's solution and state the results of your tests.

SUGGESTIONS FOR LABORATORY PRACTICE

In connection with the study of the text of the preceding chapter make:

Cake icing. Use this on Marguerites.

Candy, and compare the cost of home-made with factory candy.

Caramel sauce.

CHAPTER IV

CARBOHYDRATE IN THE FORM OF STARCH

34. Composition.—Starch, which is made up of the three elements carbon, oxygen, and hydrogen, is the most important of that class of carbohydrates known as the polysaccharides. Not only is it important as a food substance, but from it is made dextrin or British gum, commercial glucose, and other products.

35. Source and Structure.—Starch is formed in all plants. It is the form in which the plant stores its food for future consumption and is confined in tiny sacs or cells. The seeds, roots, tubers, and bulbs are the storage points. If examined under the microscope, the starch is seen to be in the form of minute granules or grains which differ in size and shape according to the source from which they come. The grains in potato starch, Fig. 2, are relatively large, being $\frac{1}{300}$ of an inch in diameter and shaped like a kidney bean. The grains of wheat starch are small, $\frac{1}{1000}$ of an inch in diameter. The walls of the cells are composed of cellulose. Starch is obtained commercially from corn, potatoes, and wheat. Glucose, as has been stated, is produced from starch by subjecting it to the action of acids. Dextrin and maltose are intermediate products of this action.

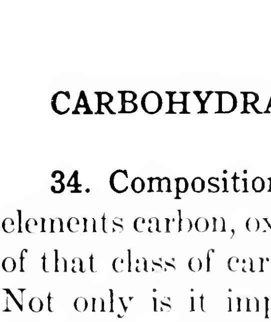


FIG. 2.—Grains of potato starch.

36. Food Value.—Starch from different sources forms

a large part of our diet, and because it can be manufactured by the plant from carbon dioxide and water, it is an inexpensive product.

As the starch in its natural state is not soluble and therefore cannot be made available to the body, it must be changed chemically during the process of digestion. This change is brought about by the action of certain enzymes found in the mouth, pancreatic, and intestinal juices. The effect of their action is to change the starch first into dextrin, then into maltose and finally into glucose, in which latter form it is absorbed into the blood stream. The ease with which these changes are affected depends greatly upon the source from which the starch comes; potato starch is supposed to be acted upon much more readily than starch from cereals. Rice starch is comparatively easy of digestion, though this ease may possibly be attributed to the small amount of cellulose present.

37. Functions of Starch in the Body.—While the chief function of starch in the body is to yield energy, this is by no means its only function. Starch plays a most important part in the construction of body tissue, appearing as it does in small quantities in the nucleo-protein of all protoplasmic tissue.

Starch also acts as a body regulator. Owing to its high oxygen content and the ease with which this oxygen may be liberated, it furnishes an excellent method of conveying this element to the various tissues. Starch, because of its non-stimulating and colloidal nature, protects the delicate walls of the intestines from the action of the more irritating crystalloids or sugars.

The body shows a decided preference for starch as a source of energy, and the over consumption of this substance is not attended by the harmful results which follow over indulgence in other foodstuffs. When more starch is eaten than the body requires, it is stored as glycogen and later as fatty tissue, or when not stored, it is completely

oxidized to carbon dioxide and water and eliminated through the lungs and kidneys.

38. Test for Starch.—The presence of starch in a substance may be detected by the use of iodine which, when added to a solution of starch, gives a blue reaction.

39. The Cooking of Starch.—Although there is at present some question as to the desirability of the high temperature and the long cooking popularly supposed to be a necessary preliminary to the proper digestion of starch, the superior flavor of thoroughly cooked starch over that of the undercooked offers a strong plea for long cooking.

Starch will not dissolve in cold water unless modified chemically; neither does cold water affect the starch granule.

Hot water at first merely causes the starch grains to swell, thereby stretching the cellulose covering until so thin that the water will pass through. Prolonged action of boiling water brings about chemical changes which result in a soluble substance.

Owing to its physical properties, starch can be used as a thickening substance, and for this purpose it comes in the form of a white, glistening powder. When so used, it should be mixed with a cold liquid, with sugar, or with fat before adding it to a hot liquid. These substances separate the starch grains so that the hot liquid reaches all the grains at the same time, causing them to swell uniformly and produce a smooth, gelatinous mass free from lumps.

40. Cellulose.—Cellulose is classed with starch as a carbohydrate, and is the substance which forms the cell walls in all plants as well as the frame work of the plant. The amount of cellulose present varies in different parts of the plant and at different stages of the plant's growth. It is more abundant in old than in young plants. The increased difficulty of digesting vegetable foods as compared to animal food is attributed to the presence of cellulose which, by enclosing the nutrients in its fibrous envelope, prevents the free access of the digestive juices.

41. Digestion and Food Value of Cellulose.—While some animals can digest cellulose, the human digestive tract is furnished with no enzyme for this purpose. The cellulose from young plants is sometimes digested in the human organism, but this is brought about by the action of intestinal bacteria, the result being probably the formation of sugar that may yield energy.

Cellulose cannot be regarded as having much food value, but it does fulfill a mission in giving a certain amount of bulk to the food and acting as a stimulant to peristaltic action. The virtue attributed to the cellulose present in certain whole grains is now questioned, and the theory is advanced that the stimulating properties of the grains may be due to the salts found in the grain covering rather than to the covering itself.

42. Dextrin.—Dextrin is made from starch which has been subjected to a high degree of dry heat, 200° C., and also by heating starch with dilute acid. It is soluble in water and is more digestible than starch, having taken one step towards the formation of sugar. This fact accounts for the increased digestibility of the crust of bread over the crumb, and of crisp toast over plain bread.

43. Glycogen.—Glycogen, sometimes called "animal starch," is the form of starch found stored in the liver and muscles of the body. After meals, when there is a specified amount of glucose in the blood of the portal vein and sufficient oxygen is present, the liver changes glucose (sugar) into glycogen and holds it until called for by the tissues. Later on, however, the liver changes some of this glycogen back into sugar in order to provide oxygen for its own respiration.

44. Less Familiar Forms of Starch.—(1) *Tapioca* is derived from a plant of the cassava variety belonging to the milk weed family. These plants are poisonous owing to the natural development in them of prussic acid. This, however, is a volatile substance, and when the cassava

root is heated or boiled or even subjected to the direct rays of the sun for a few hours, most of the poisonous material disappears.

The tapioca is prepared by grinding the root of the plant, then washing it in water and, while the starch is still saturated with moisture, subjecting it to a low degree of heat which is gradually increased until the starch grains are disintegrated into a firm, gelatinous mass. The heat is then continued at a suitable temperature until all the moisture is evaporated. To this process is due the ease with which tapioca is cooked and digested.

(2) *Sago or Palm Starch* is made from the pith of the sago palm. It closely resembles tapioca.

(3) *Arrowroot* is so named from the fact that the natives in the countries where it grows use the bruised rhizomes of the plant as a poultice for poisoned arrow wounds. The starch from arrowroot has greater thickening properties than starch from other sources.

EXPERIMENTS

Experiment 1. Potato Starch.—Grate a raw potato into a piece of cheese-cloth, squeeze out all water and wash the contents of the cloth thoroughly in cold water. Allow the water to clear, pour off the clear liquid, and dry the residue at a temperature of 70° C. in a water bath. Test a small portion of the residue with iodine. Use one teaspoonful or this starch to thicken ½ cup of liquid. Use one teaspoonful of corn starch to thicken ½ cup of liquid. Compare the thickening properties of potato starch and corn starch. Dry the fibrous substance left in the cloth to show the cellulose.

Experiment 2. Effect of Boiling Water on Dry Starch.—Pour boiling water on dry starch and observe the effect. Break open and examine the lumps formed.

Experiment 3. Effect of Boiling Water and Stirring upon Starch.—(*a*) Mix two tablespoonfuls of starch with two tablespoonfuls of cold water. Add ¼ cup of boiling water, stirring constantly. Note the effect.

(*b*) Proceed as above, using one tablespoonful of sugar in place of cold water. Add boiling water. Note the effect.

(*c*) Proceed as in (*a*), using two tablespoonfuls of fat in place of cold water. Add boiling water. Note the effect.

Experiment 4. Effect of Acid on Starch.—(*a*) Add lemon juice to a starch solution and continue cooking. Observe the effect and explain. Divide the result in two portions.

(*b*) Test result of (*a*) with iodine.

(*c*) Test result of (*a*) with Fehling's solution.

Explain.

Experiment 5. Experiment Showing Starch Digestion.—Collect and filter a small amount of saliva. Add it to starch paste in a test tube. Keep the tube in a water bath not above 98° F. for fifteen minutes.

Test one-half the amount with iodine.

Test one-half the amount with Fehling's solution.

Explain the results of the tests.

SUGGESTIONS FOR LABORATORY PRACTICE

In connection with the study of the text of the preceding chapter:

Make a mould of corn starch pudding.

Make a cup of medium white sauce.

CHAPTER V

CEREAL FOODS

45. Cereals.—The cereals, so named, from Ceres, goddess of grain and the harvest, include the grains or cultivated grasses whose seeds are used for food. The cereals most used in the various preparations known as breakfast foods are wheat, oats, and Indian corn or maize.

Rice, rye, barley and buckwheat belong to the cereals, but they are not commonly made into mush or porridge to be served as a breakfast dish.

46. Wheat.—Wheat is the typical bread-making grain, although innumerable preparations of wheat in the form of breakfast foods are to be found on the market. Of these *Farina*, *Wheatena*, and *Cream of Wheat*, in which the wheat kernels are finely ground, are very generally used. *Cracked Wheat*, *Pettijohn*, *Shredded Wheat*, and *Puffed Wheat*, are all well-known preparations.

47. Oats.—From Table III, in which is given the composition of cereals, it will be seen that oats are rich in protein, fat, and mineral matter. They contain also a good percentage of carbohydrate. Oats are probably the most nutritious of all the cereals

In the preparation of whole oats, or Scotch oats, the grains are first scoured and the husk removed. For the rolled oat products, the form in which oats are most commonly used as breakfast food, the grains are rolled instead of being crushed or ground, that is, they are subjected to great pressure which breaks down the cellulose and flattens the grains so that they are easily softened by the cooking process. By the application of heat during the rolling

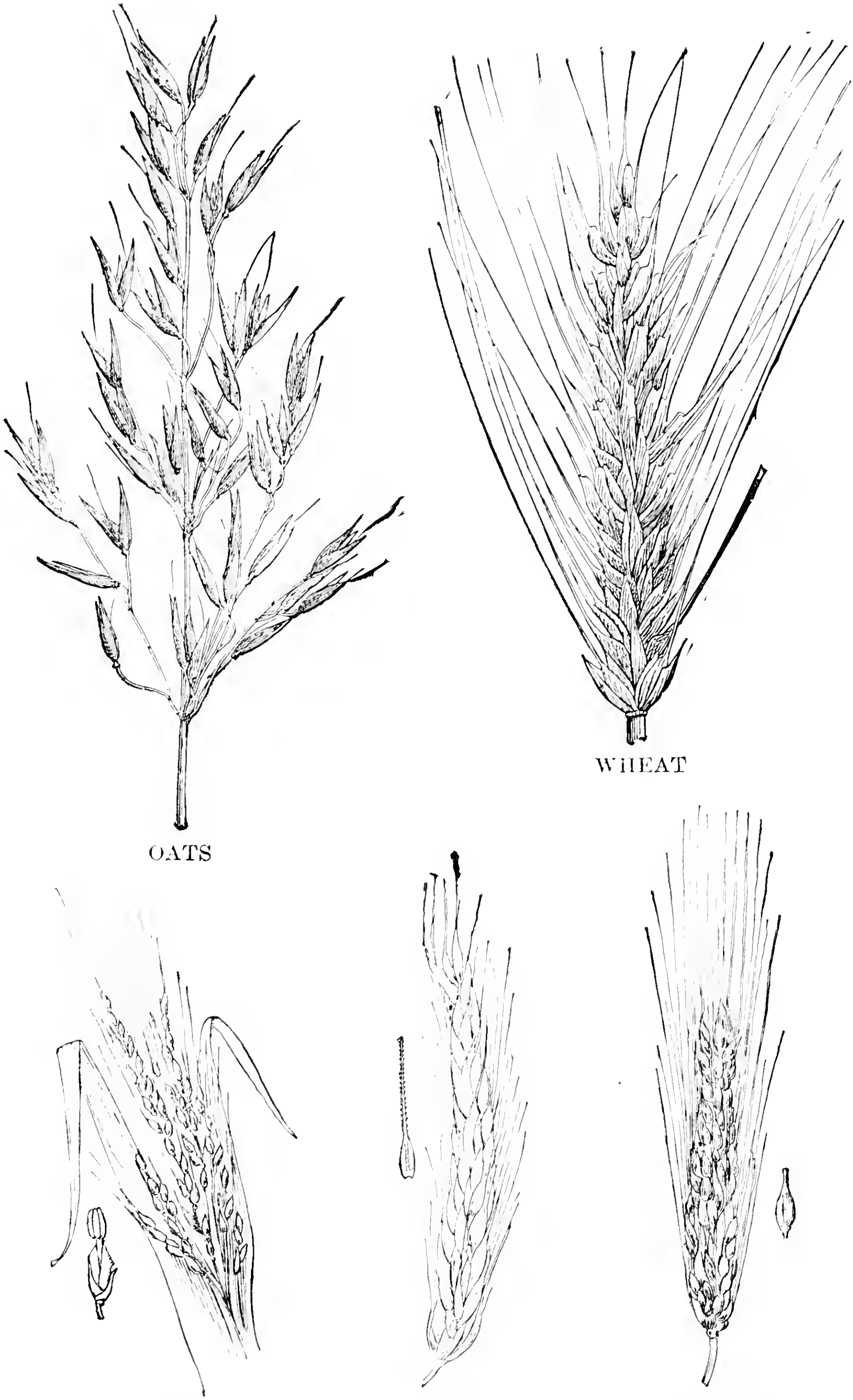


FIG. 3.—Heads of the common grains.

process, the grains are partially cooked, though not to the extent claimed upon most packages.

This application of heat is also said to act upon the fats present in such a manner as to preserve their natural flavor and to prevent them from becoming *rancid* when they stand.

48. Indian Corn or Maize.—Corn is a native American plant, and is important as a crop in this country because of its value as food for man and for fattening animals.

Corn is used for food chiefly in the form of meal, from which mush and many varieties of hot breads are made. *Meal* is the name given to the product made by grinding a whole grain without separating or bolting to remove the outside or bran coats. Yellow corn meal and white corn meal have practically the same food value, and may be used interchangeably in preparing corn dishes.

Hominy, *samp*, and *hulled corn*, are other preparations of corn in which the kernels are broken to varying degrees of fineness. Hominy is popular as a breakfast food, while samp and hulled corn are gaining in favor as a dinner dish in place of potatoes or other starchy foods.

Commercial starch and corn syrup, or commercial glucose, are made from corn.

49. Rice.—While rice is the poorest of all the cereals in protein and fat content, it has the highest percentage of starch. This starch is found in small and easily digested granules, which give to rice a special dietetic value in certain diseases. Rice is eaten whole with cream or milk or in soups. The polishing of rice, by which a part of the outer coat is removed, improves its appearance and increases its selling quality, but decreases its nutritive value. About one-half of the mineral matter, which is chiefly in the form of phosphates, is lost in the polishing process. This mineral matter is of great importance in the maintenance of health. People are coming to realize this fact and to demand of the dealers the brown or unpolished rice.

Fig. 4.—Corn.

(From McCall's "Studies of Crops.")

50. Buckwheat.—Although buckwheat is not a cereal in the sense of belonging to the grasses, it is sometimes grouped with the cereals as a matter of convenience. From this grain is made the flour which is used for buckwheat cakes. It also forms a poultry food highly prized by poultrymen, as it is popularly thought to increase the laying capacity of the hens.

51. Barley.—The chief characteristic of barley is its richness in mineral matter. Barley is sold as *pearl barley*, which is the whole kernel after the hull has been removed by machinery, and in the form of a *meal* used in preparing barley water and barley gruel. The meal is also mixed with other meals in the making of a black bread extensively used in some countries.

In this country barley is used largely in the production of *malt*.

52. Rye.—Because of the amount and quality of the gluten it contains, rye flour can be made into bread. This is practically the only use made of this grain in the United States.

It should be noted that, of all grains, wheat and rye are the only ones that contain gluten in the proper proportion to make bread of a light and porous texture.

TABLE III.—PERCENTAGE OF FOODSTUFFS IN DIFFERENT CEREALS

Cereal.	Protein.	Carbohydrate.	Fat.	Mineral Matter.	Water.	Cellulose.
Wheat	11.0	71.2	1.7	1.9	12.0	2.2
Rye	10.2	72.3	2.3	2.1	11.0	2.1
Rice (polished)	6.9	79.4	0.4	.5	12.4	.4
Rice (in husks)	6.8	68.1	1.6	4.0	10.5	9.0
Oats	13.0	68.6	8.1	2.1	6.9	1.3
Maize	9.7	68.9	5.4	1.5	12.5	2.0
Barley	10.1	69.5	1.9	2.4	12.3	11.8
Buckwheat	10.2	64.3	2.2	2.2	13.0	11.1

53. Digestibility of Cereals.—The digestibility of all cereal products depends largely upon the thoroughness with which they are cooked. It is desirable that the cell walls of the starch grains be softened and ruptured by thorough cooking to prepare them for the action of the digestive fluids. It has been demonstrated that cooked starch is more easily and quickly changed to maltose than raw starch.

As a group, the nutrients of the cereals are readily absorbed and assimilated. Cereals rank next to the animal foods in this respect. The cellulose, which is not itself digested, furnishes bulk to the food to excite the peristaltic motion of the stomach and hasten the digestive process.

Thorough mastication is essential with starchy foods, since it not only divides the food into smaller particles but also insures a thorough mixing with the saliva, thus making possible the action of the ptyalin on the starch.

Fruits eaten with cereals are valuable aids to digestion, as the added flavor and increased attractiveness of the dish stimulates the glands to an increased flow of digestive juices.

Numerous uncooked cereal preparations are offered for sale. These have the advantage of being ready for immediate use, thereby saving time, labor, and fuel, but undoubtedly have a questionable nutritive value, as compared with the cooked whole grains.

54. The Use of Sealed Packages.—Package cereal foods, although more expensive than the same weight sold in bulk, are usually to be preferred on account of the possibility of greater cleanliness which they offer. The packages are sealed to protect the contents from dust, dirt and germs, and the additional few cents per pound in cost is a wise expenditure of money. So much stress has been placed upon this precaution of recent years that it is now almost impossible to obtain cereals in bulk.

55. Cooking Cereals.—The chief purposes in cooking

cereals are to sterilize them, to improve their flavor and appearance, and to make them more digestible by breaking down the cell walls, thus enabling the digestive juices to reach the nutrients.

Since it has been found that starch grains are not ruptured by heat below that of the boiling-point of water, it is important that the first part of the cooking process should take place at that temperature. This may be accomplished by placing the vessel containing the cereal directly over the fire for the first five or ten minutes, after which the cereal may be allowed to steam until completely cooked. The time required for cooking varies with the kind of grain and the method of preparation. In general, the finely ground or rolled products require less time than the whole grains.

The theory that long exposure to a high temperature is harmful to the growth-producing element found in the whole grain should be considered, and excessive heating should be guarded against.

Before cereals are ready for eating, a sufficient amount of water must be added to swell the starch grains and form a mixture of the proper consistency. As a rule the coarse-rolled grains require twice as much liquid as there is cereal, and the finely ground wheat or corn products about four times as much.

Table IV shows the proportions of cereal and water, and time of cooking for the different cereal foods.

56. Fruits and other Accompaniments to Cereals.—Since the cereal foods are largely carbohydrate, the addition of fruits, fresh or stewed, increases their nutritive value by adding mineral salts and other nutrients, as well as their palatability by supplying flavor and variety. Dates, figs, or raisins, moulded with the cereal and served with cream, make a pleasing and satisfying luncheon dish for children. Fresh fruits, such as berries, bananas, and ripe peaches, are a suitable addition to the uncooked and to

TABLE IV.—PROPORTIONS AND TIME OF COOKING FOR THE COMMON CEREALS

Kind.	Amt. Cereal, Cups.	Water, Cups.	Time, Hours.
Rolled oats H.O. Quaker oats	1	2	1
Whole oats	1	4	6–8
Pettijohn	1	2	1
Whole wheat	1	4	6–8
Cream of wheat Wheatena	1	4	1
Corn meal	1	$3\frac{1}{2}$	3
Hominy	1	4	1
Rice (steamed)	1	$2\frac{1}{2}$	2
Rice (boiled)	1	8–12	20 min.
Barley (steamed)	1	3	2

many of the cooked cereals. The acid and mineral substances which they contain are desirable adjuncts to starchy foods.

Starch, as has been stated, is converted into sugar in the digestive process, therefore sugar is an unnecessary addition to breakfast foods except to give flavor. If used at all, it should be used sparingly. Milk and cream, however, supply the protein and the fat in which cereals are more or less deficient, and in addition furnish the growth-stimulating principles or vitamines which milk and cream are known to contain.

57. Macaroni, Spaghetti and Noodles.—Macaroni, spaghetti and kindred substances are made from a hard, spring wheat flour which is rich in gluten. Because of the gluten, a substance is produced which can be drawn or moulded into various different forms such as tubes, shreds, letters, etc. Water is added to the flour to make a paste of the proper consistency, which, when formed as desired, is thoroughly dried. All of these products absorb about three

times their weight of water in cooking and increase in bulk to a corresponding degree.

Domestic macaroni and similar products manufactured in factories in this country are to be preferred to the home-made products of uncertain cleanliness. Good macaroni may be judged by its deep cream color and rough texture. The best macaroni breaks without splitting and keeps its shape after cooking.

By the addition of cheese or various other sauces to macaroni or spaghetti, a simple and satisfying meat substitute may be made.

Noodles, made from flour, salt, and egg, in a variety of forms, are added to soup stock to make noodle soup or may be served in place of a vegetable with the meat course.

58. Use of the Double Boiler.—A double boiler, or its equivalent, a small sauce pan placed in a larger pan of water, is commonly used in cooking cereals. When the cereal has been started in the inner boiler directly over the fire, the parts of the boiler are placed together and the cooking completed by the dry-steaming method. The double boiler does away with the necessity for stirring and watching to keep the food from burning. The only care required is to keep the lower part of the boiler or the larger saucepan one-third, or thereabouts, full of water. The food in the inner boiler never reaches the boiling-point, therefore a much longer time is required for thorough cooking.

59. The Fireless Cooker.—In Fig. 5, are shown the essential parts of a fireless cooker. The food to be cooked is first placed in one of the covered metal containers and heated over the fire to the boiling-point or cooked for a given time as indicated in Table V. The container with its contents is then placed in the food chamber, which is surrounded by a good insulator to retain the heat and utilize it for cooking the food. All commercial fireless cookers are equipped with one or more hot plates or radiators

for use in baking and in maintaining a cooking temperature for a longer period of time. These plates are first heated over the fire and then placed in the cooking chamber underneath or above the food container. The racks upon which these plates rest, when the cooker is used for baking purposes, surround the space occupied by the bread or cake.

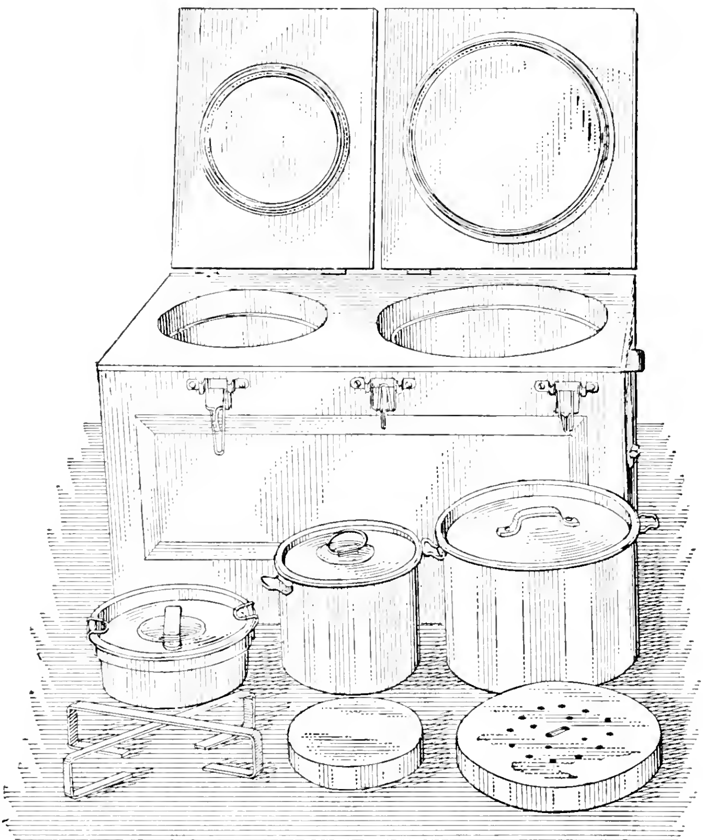


Fig. 5.—A commercial fireless cooker.

The principle upon which the fireless cooker is based may be applied to the keeping of iced or frozen mixtures at a low temperature. In this case the heat-insulating material surrounding the food chamber prevents the entrance of heat from without, and thus maintains the low temperature of the food. If the cooker is well insulated, a food

may be cooking in one compartment while a mixture is kept chilled in another compartment of the same cooker.

60. Selection and Care of Fireless Cookers.—In choosing a fireless cooker the attention should be directed to the durability of the different parts. The outside case or box may be of finished hard wood or metal, preferably of metal because it is easier to keep clean. The lining of this box should be of a durable material and at the same time one that will clean easily. The food chamber should have a seamless metal lining to prevent the collection of germs. The food containers should also be free from seams or corners where particles of food might find a hiding place. Each food container should be fitted with a tight cover held in place by fasteners. The hot plates are best when made of soapstone, which heats slowly but retains the heat for a long time. The racks should be firm and strong enough to bear the weight of the hot plates.

Various non-metal substances, such as asbestos, excelsior, or paper, are used for insulating the different cookers. The more perfect the insulation the better the results. A vacuum, the insulator employed in the construction of some of the more expensive cookers, is the most effective means of maintaining a constant temperature.

FIG. 6.—A home-made fireless cooker.

61. A Home-made Fireless Cooker.—An improvised cooker that will serve the designed purpose in a satisfactory manner may be constructed at a very slight cost. Such a one is shown in Fig. 6. A box, lard pail, candy pail, or other container having a tightly fitting cover; an agate, tin, or aluminum cooking utensil, also having a close fitting cover; and asbestos, hay, cork, paper, or excelsior for packing purposes, are the essential things.

To make the cooker select a box or other container of

suitable size, having the required tight cover, and line it throughout with asbestos or paper. Choose an inner food container, having a tight cover, of suitable size to allow for a three-inch space between it and the outer box or pail, and cover with asbestos or stout paper. Pack the bottom of the box three or more inches deep with one of the above-mentioned insulating materials. Put the covered container in place on the bottom pad and pack the space around it with more of the insulating material, filling the space within three inches of the top of the box.

Make a pad of muslin filled with the insulating material, that will exactly fit and fill the box. Close the fitted cover tightly when in use. The insulating packing material should be changed frequently to keep the cooker clean and free from odors.

62. The Use of the Fireless Cooker.—Cereals are probably the food suited above all others to cooking in the fireless cooker. Dried beans, peas and lentils, which have a high starch content linked with protein and require long cooking, are palatably and economically prepared in the fireless cooker.

Tough cuts of meat, such as are used in preparing soup stock and stews, and especially tough fowls are successfully cooked in a fireless cooker. Corned beef, hams, tongues, and other cured or salted meats shrink less when cooked in this way. In fact the cooker is admirably suited to all foods requiring a long, slow cooking to make them palatable and digestible.

It is, however, of extreme importance that the foods thus cooked be reheated before serving, to remove any gases that may have been formed in the slow-cooking process.

The fireless cooker is recommended highly for use in canning small fruits such as cherries and all kinds of berries. The bright color is preserved and the appearance of the canned goods much improved by this method of canning.

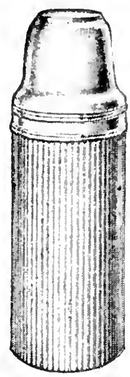
A more extended use of the fireless cooker is recommended for housekeepers who are obliged to be away from home the greater part of the day. The saving in both time and fuel will overbalance the initial cost of the cooker.

TABLE 5.—TABLE FOR COOKING SOME COMMON FOODS IN THE FIRELESS COOKER. (MITCHELL)

Food.	Amount.	Amount of Water.	Amount of Salt.	Time on Stove in Minutes.	Time in Cooker in Hours.
Rolled oats	1 c.	2½ c.	1 tsp.	5	2–12
Corn meal mush	1 c.	4½ c.	1 tsp.	5	5–10
Hominy	1 c.	5 c.	1½ tsp.	10	10–12
Rice	1 c.	2½ c.	1 tsp.	Bring to boiling point.	1
Soup stock	2 lbs. meat	2 qts.	1 tbs.	10 simmering	9–12
Stew	1 lb. meat	2½ c.	1 tsp.	5 simmering	4–6
Corned beef	8 lbs.	Water to cover		Simmer, 30–40	10–12
Tongue	......	Water to cover		Simmer 20–30	10–12
Ham	......	Water to cover		Simmer 20–30	7–10
Dried beans, peas, or lentils	1 c.	3 qts.	To taste	Boiling-point	8–10

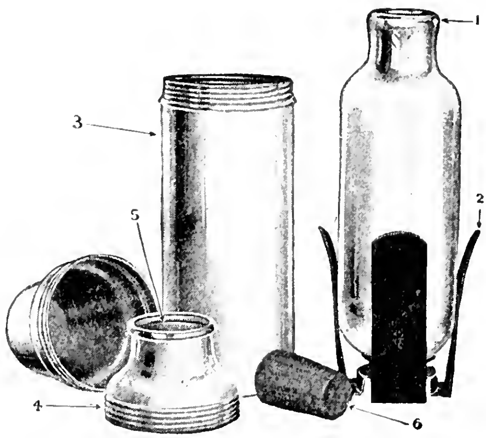
63. The Thermos Bottle.—The various styles of thermos or vacuum bottles now in use depend upon the vacuum surrounding the inner bottle to act as insulator to maintain the temperature of the contents of the bottle. This is an application of the same principle as that upon which the fireless cooker is based.

In Fig. 7, is shown a thermos bottle closed, and in Fig. 8, the construction of the same. The glass vessel in Fig. 8 is double walled with a vacuum or insulating space between. This glass vessel is set upon a spring in the outer container which prevents breakage in handling. The material of the outer container may be of tin, agate,



Courtesy of Landers, Frary & Clark.

Fig. 7.—Thermos bottle closed.



Courtesy of Landers, Frary & Clark.

Fig. 8.—Vacuum bottle showing the various parts.

1 Vacuum vessel or glass filler;
2 The spring steel shock absorber;
3 Nickel-plated brass case in which glass filler is placed, resting on shock absorber;
4 Nickel-plated shoulder which screws to case, holds filler in place;
5 Gasket which fits to neck of bottle so that no liquid can enter case;
6 Cork stopper;
7 Nickel-plated cap or drinking cup which screws to base.

glass, nickel, silver, etc., depending upon the price and the use.

The convenience, comfort and value of the thermos bottle for the school lunch box, the laborer's lunch box, picnic parties, and long motor trips cannot be overestimated. The range of prices brings some kind of a vacuum bottle within the reach of all.

64. The Pressure Cooker.—A steam pressure cooker, Fig. 9, made of solid aluminum and equipped with a steam gauge which registers the amount of steam pressure used, is to be had in sizes suitable for family use. Cooking food under steam pressure in the home is a comparatively new idea and one that is not yet in general use. The points which recommend the pressure cooker to the housekeeper are the saving in time, labor and fuel. Foods will cook in one-half or less time than in the ordinary cooking utensils. The pressure cooker is highly recommended for use in canning fruits and vegetables because it shortens the period of sterilization.

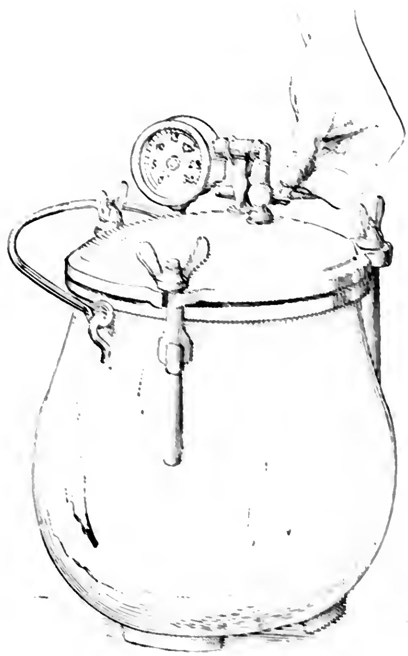


FIG. 9.—Pressure cooker. (Farmers' Bulletin 839, U. S. Dept. of Agr.)

The high price of the pressure cooker as now made places it beyond the reach of the average household, although it is claimed that by the saving in fuel alone it will pay for itself in a short time.

SUGGESTIONS FOR LABORATORY PRACTICE

In connection with the study of the text of the preceding chapter:
Cook oatmeal in a fireless cooker.
Cook rolled oats as an example of coarse cereals.
Cook farina as an example of fine cereals.
Boil and steam rice.
Cook macaroni or spaghetti and serve with white sauce.

CHAPTER VI

FLOUR MIXTURES

65. Definition.—Flour mixtures are such mixtures as contain flour as the chief ingredient. The essentials in flour mixtures are flour, liquid, salt, and some kind of a leavening agent. The additions, or non-essentials, are the ingredients added to produce an agreeable taste, to improve the texture, or to introduce a larger proportion of nutrients. These are seasoning, shortening, fruit, nuts, and flavorings.

66. Leavening Agents.—To leaven means "to make light." It is necessary to introduce some kind of a leavening substance into a flour mixture to render the mixture light, porous, and digestible. A leavening agent as used in cookery is a substance which contains a gas, or which has the power to produce a gas. The expansion of this gas during the process of baking causes the mixture to rise.

The leavens are air, steam, and gas, produced by the action of some kind of a leavening agent incorporated in the mixture.

Air is the simplest of the leavens. By beating, folding or rolling a mixture, a sufficient volume of air is often introduced to cause the mixture to rise satisfactorily. Examples of such mixtures are sponge cake, pie crust, and beaten biscuit.

The *steam* produced from the liquid added to a mixture, together with the air incorporated by beating or other manipulation, forms the leaven in such mixtures as pop-over batter.

Gas produced by chemical agents introduced into the mixture for this purpose, such as baking powder and bicarbonate of soda, is the ordinary leavening agent made use

of when time cannot be allowed for the longer process of fermentation. Examples are quick bread and cake mixtures.

A second way in which gas for leavening may be produced within the mixture is by the use of *yeast*. The yeast causes alcoholic fermentation of the sugar present, setting free the gas, carbon dioxide (CO_2). This is the purpose of the yeast used in bread making.

67. Baking Powders.—Three different kinds of baking powder are in general use. All of thes contain bicarbonate of soda as a source of carbon dioxide (CO_2) and require an acid reagent capable of liberating this gas.

Tartrate powders are those in which tartaric acid or its salt, cream of tartar, is employed as this acid reagent.

Phosphate powders are those made with calcium or sodium phosphate as the acid reagent. Crystallized monosodium phosphate as produced by a recently demonstrated chemical process is the phosphate used in the best of this class of powders.

Alum powders are those in which the ammonium and sodium alums are used to release the gas.

In addition to the above chemicals a small amount, about 20 per cent, of corn starch or some other substance is used to prevent the gathering of moisture which will cause deterioration of the powder.

There is also in each case a small amount of residue or by-product resulting from the action of the ingredients in the powder. It is a question whether this by-product is, in any case, as harmful as was formerly believed. Discussions of the relative merits of the different powders savor so much of commercialism that it is hard to find unprejudiced information on this point. It is safe to say that in the small amounts in which baking powders are ordinarily used, the deleterious effects from the by-products are negligible.

68. Analysis of a Cream of Tartar Baking Powder.—Cream of tartar baking powder is composed of two parts

by weight of acid potassium tartrate, or cream of tartar, to one part of bicarbonate of soda, with an addition of twenty per cent of starch as a filler. When this compound comes in contact with the liquor in a batter or a dough, the two soluble ingredients gradually dissolve. In solution a chemical change takes place and new compounds, carbon dioxide and sodium-potassium tartrate, commonly known as Rochelle Salts, are formed, as is shown by the following reactions:

Acid potassium tartrate.		Bicarbonate soda.		Sodium-potassium tartrate.
$HKC_4H_4O_6$	$+$	$NaHCO_3$	$=$	$NaKC_4H_4O_6+CO_2+H_2O$

69. Source of Cream of Tartar.—Cream of tartar, together with other salts and some coloring matter, is found as a deposit in the form of crystals called *argols* on the sides of wine vats. These argols are melted and filtered through bone black to remove the color and other impurities. The resulting liquid is then recrystallized as pure cream of tartar. These crystals are ground to an extremely fine powder before combining with soda to form baking powder.

70. Source of Bicarbonate of Soda.—Although there are other ways of making bicarbonate of soda or baking soda, the ammonia or *Solvay process*, with reactions as shown below, is still used. Equation (1) shows the chief reaction, while equation (2) shows the recovery of the ammonia, which is the key to the commercial success of this process.

(1) $NaCl+NH_4+H_2O+CO_2=NH_4Cl+NaHCO_3$.

(2) $2NH_4Cl+Ca(OH)_2=CaCl_2+H_2O+2NH_4$.

71. Action of Soda with Sour Milk, Molasses and Chocolate.—Sour milk contains an acid (*lactic*) which acts chemically upon bicarbonate of soda, setting free the CO_2. Sour milk and soda may be substituted for sweet milk and baking powder in making many of the quick breads and cakes. The chief difficulty for the beginner is to determine the degree of acidity of the milk and to know how much

soda is required. Ordinarily one-half teaspoonful of soda will be sufficient for one cup of sour milk or buttermilk.

In using molasses the free acid present will be neutralized by the addition of one-half teaspoonful of soda for each cupful of molasses.

Soda has the power to darken the chocolate in a mixture and to neutralize the free fatty acids present in the chocolate and release the gas.

72. Home-made Baking Powder.—Many housekeepers prefer to use cream of tartar and baking soda as a substitute for baking powder. When so used, a scant teaspoonful of soda mixed with two teaspoonfuls of cream of tartar is an equivalent for three teaspoonfuls of baking powder. It is best to prepare a small quantity of the mixture in the proper proportion and have it ready for use as required. The materials should be weighed accurately and mixed thoroughly by sifting several times after combining. This mixture should be kept tightly covered in a glass jar.

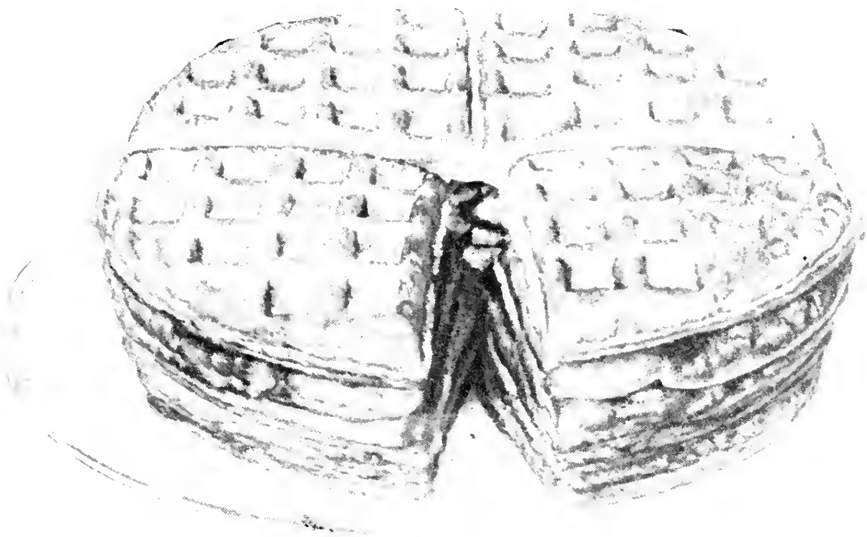
73. Classification of Flour Mixtures.—According to kind:

(1) Bread	Hot or quick breads Yeast breads
(2) Cake	Sponge Butter
(3) Pastry	Pies Tarts Patties

According to thickness:

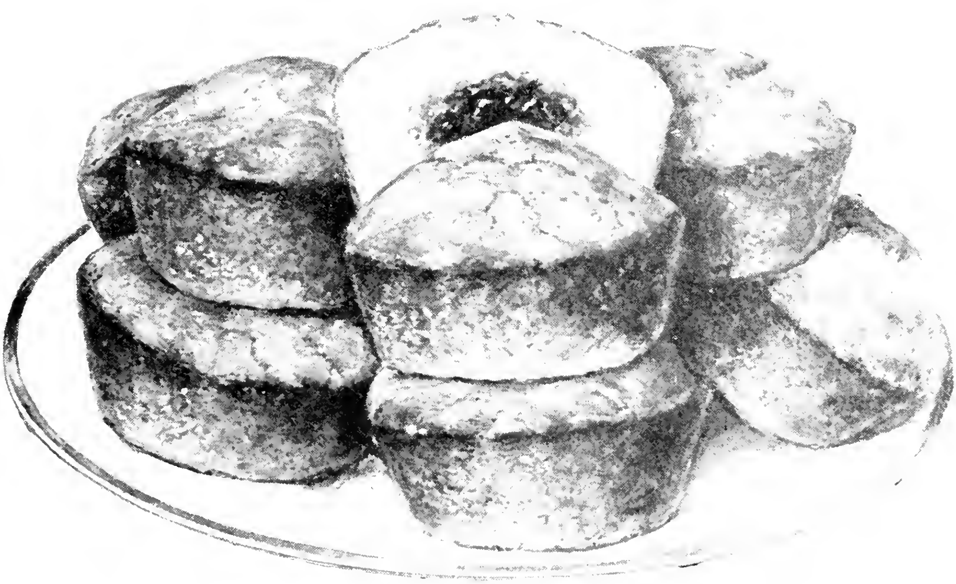
(1) Batters	Pour Drop
(2) Doughs	Soft Stiff

A *batter* is a mixture of some starchy substance, as flour or meal, and a liquid, in proportions to form a combination that can be beaten with a spoon.



Courtesy of Royal Baking Powder Co.

Fig. 10.—Waffles.



Courtesy of Royal Baking Powder Co.

Fig. 11.—Muffins.

A *dough* is a flour mixture stiff enough to be kneaded on a board.

Pour-batter is the thinnest of the flour mixtures, and contains about an equal amount of flour and liquid. A definite proportion cannot always be maintained, since there is a variation in the thickening power of the different flours, as well as in the wetting capacity of the different liquid ingredients. Griddle cake mixture and pop-over batter are excellent examples of this class of flour mixtures.

Drop-batter is a mixture containing approximately two parts of flour to one part of liquid. A good example is muffin batter. In this case as in the case of the pour-batters, the proportion of the essential ingredients will depend upon the kind of flour used and upon the properties of the other ingredients.

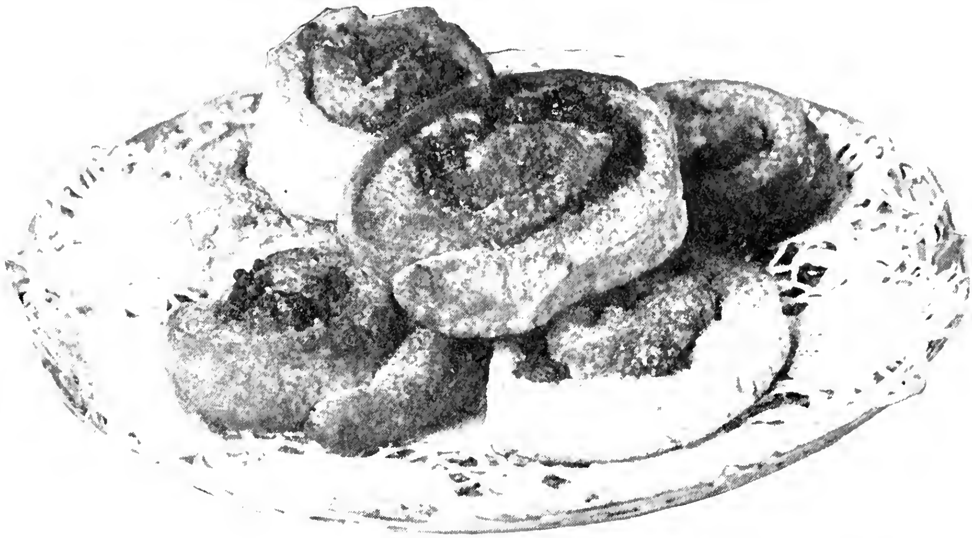
Soft-dough contains from two and one-half to three parts of flour to one part of liquid. Biscuit dough is typical of this class.

Stiff-dough has the proportion of flour and liquid of four to one. Pie crust is the best example of this class of doughs.

74. Hot or Quick Breads.—As the name indicates, hot or quick breads are prepared in a much shorter time than that necessarily taken for yeast breads which are discussed in the succeeding chapter. Some chemical means of producing CO_2 is depended upon to give the necessary lightness to this class of breads.

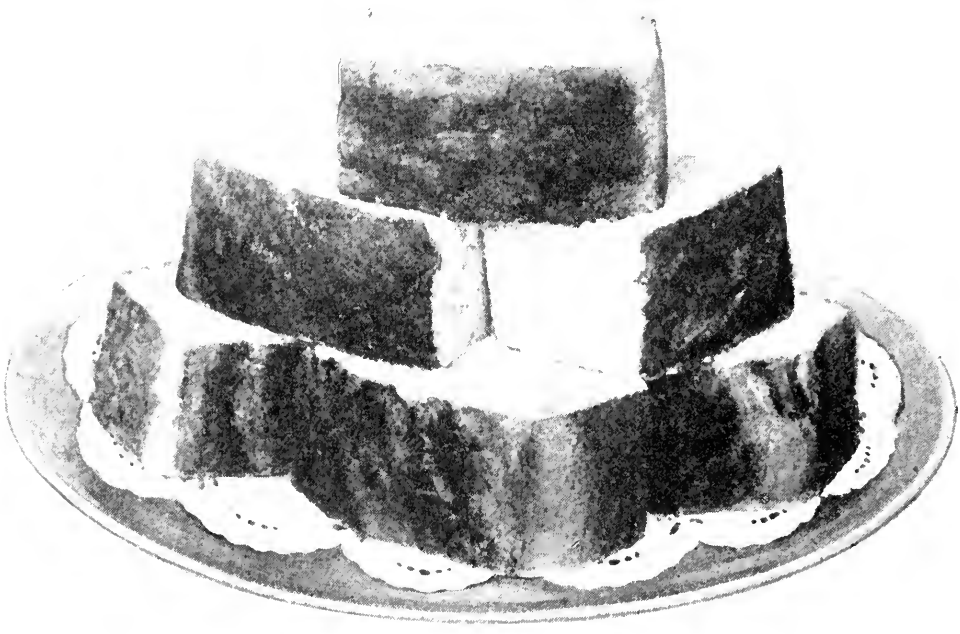
75. Cakes.—The cake mixtures are divided into two classes, *sponge* and *butter*. The first class comprises all varieties of cake batter not containing shortening of any kind and depending upon air for leavening. The second class includes all forms of cake batter which contain butter or other fats and depend upon the gas released from soda, as in baking powder, or the use of baking soda and some acid substance, for leavening.

76. Sponge Cake.—This is the simplest of the cake



Courtesy of Royal Baking Powder Co.

FIG. 12.—Cinnamon Buns.



Courtesy of Royal Baking Powder Co.

FIG. 13.—Corn Cake.

mixtures in respect to the number of ingredients, but it is the most difficult to make successfully. Since air is depended upon for leavening, it is most essential that the means of combining the few ingredients be the one that will imprison the greatest amount of air. The white of egg will hold more air than the yolk, therefore the parts of the egg are beaten separately and, as a last step, the stiffly beaten white is carefully folded into the other ingredients.

More air may be incorporated into the white of egg than into almost any other substance, because of the albumin it contains. When beaten this albumin forms the wall

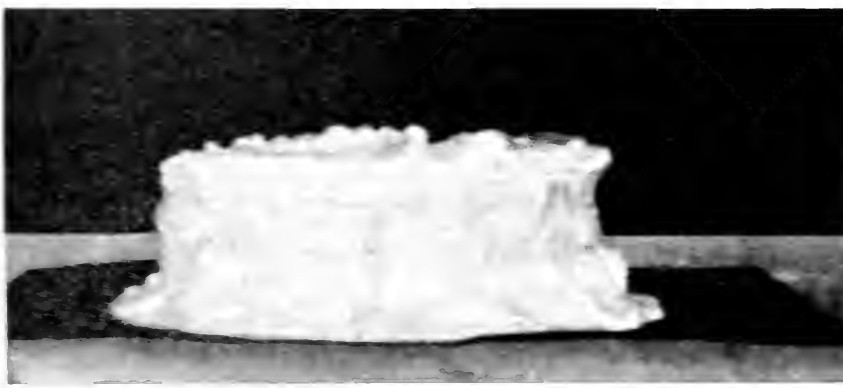


FIG. 14.—Butter Cake.

inclosing the air bubbles. The addition of acids, such as lemon juice or cream of tartar, toughens this thin albuminous covering, and makes it possible for the gas to expand without rupturing the containing wall, thus giving the spongy texture from which the cake derives its name.

77. Butter Cake.—Butter cake mixture is a modified muffin batter. More shortening, sugar, and egg is used and some kind of flavoring substance is added, together with the special ingredient which determines the particular variety of cake; e.g. chocolate, fruit, nut, etc.

78. Ingredients and Their Effect on the Mixture.*—For

* Suggested by Cornell Bulletin No. 73.

satisfactory results in cake making, it is most essential that all the ingredients should be of the best quality in respect to flavor and freshness.

Flour.—A good, standard grade of flour should be used. This should be sifted twice before measuring. There is less variation in the weight of different flours after they are sifted twice, and more uniform results may be obtained through observing this precaution. Flour is sifted to remove foreign substances, to take out lumps, and to incorporate air. The amount of air introduced is greatly increased by a second sifting. Many cake rules call for pastry flour but when this is not obtainable, bread flour may be substituted, using two tablespoonfuls less for each cupful of flour than the rule specifies. It has been demonstrated that two tablespoonfuls of cornstarch added to each cup of bread flour makes an excellent substitute for pastry flour.

Too much flour in a cake will cause it to become tough and bread-like. On the other hand, if not enough flour is used, the cake will fall because there is not enough gluten in the mixture to stiffen on baking and hold the cake up. The starch in the flour binds the other ingredients together and gives body to the cake.

Sugar.—A fine-grained, granulated sugar should be sought for cake making, since it dissolves more readily than the coarse grained and makes a cake of finer texture. When powdered or brown sugar is used in place of granulated, it is advisable to make the substitution by weight rather than by measure, as from one and a quater to one and a half cupfuls are required to furnish an equivalent sweetening to one cupful of granulated sugar. Since sugar dissolves and increases the moisture in a cake, too much tends to make the cake rise high in the oven and then fall before the baking process is finished. In this case the crumb will be sticky and the crust gummy. Too little sugar produces a coarse-grained cake.

Butter or Other Fats.—Butter used for cake making should not have an objectionable flavor or odor, as both of these may be detected in the cake when baked. Butter has the effect of making a cake rich, tender, and of fine texture, but a definite proportion (1:4) between butter and flour should be maintained for the best results.

Cheaper fats may be substituted for butter fat for use in cake making. Of these fats, fresh lard, chicken fat, and cottonseed oil are most frequently used. A less amount of the softer fats and oils is needed when substituted for butter because they contain less moisture and are free from curds, salt, or other foreign substances and have a correspondingly greater shortening power. Seven-eighths of a cupful of lard is equivalent to one cupful of butter.

A rich cake, one that contains an excess of fat, will be fine grained, crumbly, and hard to get out of the baking tin, while one containing a small amount of fat will be light and porous but will dry out rapidly. An increase of fat in a recipe calls for a corresponding increase in the amount of flour and egg or baking powder.

Eggs.—Eggs impart lightness and smoothness of texture to a cake and help to bind the ingredients together. They also give toughness, especially the white. Therefore, when whites are used in place of yolks, one teaspoonful of fat should be added for each additional white to make up for the fat content of the yolks (⅓ of which is said to be fat). Because of this fat, which will not allow it to hold air, the egg yolk cannot be beaten to a stiff froth like the white. This is demonstrated when a little of the yolk is left in the white and prevents the formation of a stiff froth that will keep its shape.

Good cold-storage eggs, or eggs preserved by some of the common household methods, may be used instead of fresh ones when the price of strictly fresh eggs is prohibitive.

It is possible to make a cake light and at the same time good-tasting with a small amount of egg by increasing the

quantity of baking powder. An example is the one-egg or standard cake, which is good when eaten soon after making, but which dries out quickly.

Liquids.—Although sweet milk is the liquid generally called for in cake recipes, other liquids are often used. Water, which toughens the cake slightly, is probably the chief substitute for sweet milk.

Sour Milk.—When sour milk or buttermilk is used as the liquid in a cake recipe, bicarbonate of soda (one-half teaspoonul for each cupful of milk) is ordinarily required to neutralize the acid before adding baking powder.

Sour cream takes the place of both fat and liquid in a recipe. One cupful of sour cream is regarded as equivalent to one-third to one-half cupful of shortening and two-thirds to one-half cupful of sour milk.

Fruits.—Fruits are added to cake to improve the flavor, to add weight and food value and to prevent its drying out quickly. Certain dried or candied fruits such as currants, raisins, citron, cherries, figs, and dates are used in cake making. When adding dried fruits, the batter should be slightly stiffer than for plain cake, in order to hold the fruit in place. Also, more shortening should be added to counteract the effect of the extra flour used. Raw fruits, such as blue berries and cherries, require a smaller amount of extra flour. Cooked fruits apple sauce, blackberry, and other jams require very little additional flour. Dried or raw fruit should be mixed with a small amount of flour and added to the mixture just before baking.

Nuts.—Nuts, which are lighter than fruit, do not need additional flour to keep them from settling to the bottom of the tin. They add such richness to a cake mixture that one cup of nuts is equivalent to one tablespoonful of fat.

Chocolate and Cocoa.—Cocoa may be used in any recipe calling for chocolate by allowing two tablespoons of cocoa to an ounce, or a square, of chocolate. The starch found in the chocolate or cocoa thickens the batter, which accounts

for the fact that less flour or more liquid is called for when chocolate or cocoa is used. The fat of the chocolate or cocoa adds richness to the cake and may be taken into consideration in the addition of other fats.

Spices and Flavoring Extracts.—Spice may be added to a cake mixture by sifting with the dry ingredients or by first scalding with about twice as much boiling water as spice, and adding to the liquid ingredients. The latter method is highly recommended because it improves the flavor of the spice and imparts a richness to the cake.

Strong vanilla, lemon, almond, or other extracts are not needed in a cake made of good materials, and should be used only in quantities sufficient to impart a delicate flavor rather than as a disguise to the objectionable flavor and odor of poor materials.

79. Baking Cake.—Experience is the only guide to successful baking unless a reliable oven thermometer is used. More cakes have been spoiled in the baking than by faulty recipes or careless mixing. A loaf cake should be baked on the bottom shelf of the oven in order to have the greater heat underneath. Cookies and small cakes are baked more evenly on the upper shelf.

In filling the pan bring the batter up against the sides so that the center will not be higher than the sides, and in this way bring a larger proportion of the batter in contact with the heat at the sides of the pan. This makes the cake rise evenly. The pan should not be more than two-thirds full of batter, or the cake will rise over the sides of the pan and fall later.

An over-hot oven does not allow the cake to rise evenly and an oven too cool allows the mixture to become over-light, thus spoiling the texture of the cake. Since the range of oven temperature runs from 250° F. (cool) to 500° F. (very hot), some reliable means is necessary to accurately measure the heat of the oven. The methods of testing oven temperatures most commonly employed when a thermometer

is not used are: Testing with the hand, noting how quickly a piece of paper browns in the oven, and allowing a stated time after the gas has been turned on before putting in the cake. Any one of these may be adequate in the hands of an expert, but for the inexperienced the only sure method is the use of an oven thermometer.

A dish of cold water placed on the upper grate will lower the temperature of the oven. Leaving the door ajar is safe only after the cake is partly baked.

TABLE VI.—OVEN TEMPERATURES

(From Teachers' College Bulletin No. 8)

Cool.	Moderate.	Hot.	Very Hot.
250–350° F. Custards Meringues Sponge cake	350–400° F. Ginger bread Butter cakes Cookies Bread	400–450° F. Rolls Pop-overs Biscuits Muffins	450–500° F. Pastry

80. Stages in Baking a Cake.—The time required for baking a cake may be divided into four periods. First, the cake rises to its full capacity. Second, a crust is formed on top which is brown in spots. Third, the cake is an even golden brown. Fourth, it shrinks from the sides of the tin, becomes elastic to the touch and a broom splint inserted will come out clean.

81. Care After Baking.—After a cake has stood in the tin long enough to become moist around the sides, it should be removed from the tin and inverted on a rack to cool. This usually takes about three minutes. Cakes to be iced need to be partly cooled before the icing is put on or the heat of the cake will cause the icing to run.

82. How to Know a Good Cake.—A properly made cake should be of uniform thickness, fine grained, and of delicate texture. Cake that rises in the middle or at the sides of the

tin, either has too much flour in it or has been improperly baked. A coarse grain and texture indicate careless measuring or insufficient mixing. A good cake is light, tender, and moist, easily broken, but not crumbly. The crust should be thin, tender, and evenly browned.

SUGGESTIONS FOR LABORATORY PRACTICE

In connection with the study of the text of the preceding chapter:

Make pop-overs, griddle cakes, waffles, fritters, muffins, and tea biscuit.

Make sponge and butter cakes, cookies, and gingerbread.

CHAPTER VII

FLOUR MIXTURES, BREAD AND PASTRY

(Continued)

83. Varieties of Wheat.—*Spring wheat* is grown in the Northwestern States and Canada. It is sown in the spring and grows and matures during the short, hot, summer months and is harvested in the early fall. Spring wheat, because it is rich in the right kind of proteins, is considered best for bread flour.

Spring wheat flour is known by its creamy white color, its gritty feeling when rubbed between the thumb and finger, and its power to absorb water.

Winter wheat, which is sown in the fall, reaches maturity in the early summer. The kernels of winter wheat are softer and contain more starch than those of spring wheat, and for this reason winter wheat is used for making *pastry flour*. This flour is whiter in color than bread flour. It has a smooth, starchy feeling and holds its shape when squeezed in the hand.

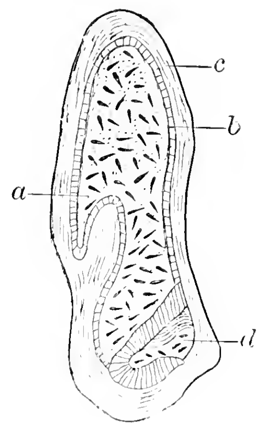


FIG. 15.—Longitudinal section of a grain of wheat.

a, endosperm;
b, aleurone cells;
c, bran coats;
d, germ.

84. Structure and Composition of a Wheat Kernel.—The structure of a wheat kernel is shown in Fig. 15. The principal parts are:

(*a*) *The endosperm*, which forms the mass of the kernel and is made up of starch and protein cells.

(*b*) *The aleurone cells*, or layer of large square cells sur-

rounding the endosperm. These are rich in phosphorus and gluten.

(*c*) *The bran coats*, which comprise several layers outside of the aleurone cells. These are rich in mineral matter. Here is also found more cellulose than in other parts of the grain.

(*d*) *The germ, or embryo*, located at one end of the kernel, is the young plant which grows on germination. It is rich in protein, fat and mineral matter.

85. The Proteins of Wheat.—The two most important proteins found in wheat are *glutenin* and *gliadin*. These are united chemically, when flour is kneaded with a liquid, and form *gluten*.

86. The Milling of Flour.—The history of the development of the milling process is an interesting topic for home reading. The roller process now in use yields about 75 per cent of the cleaned wheat as white flour. The remainder, called *shorts* and *bran*, is used for feeding cattle.

The high grade or standard flours are those made from wheat yielding not only a high percentage of gluten but a gluten that is composed of the proper proportions of gliadin and glutenin. It is the proportion in which these important proteins occur, quite as much as the total gluten content of the flour, which makes possible a large, light, and porous loaf of bread.

Whole wheat flour is wheat meal from which the coarsest of the bran has been removed. It contains the germ and a portion of the aleurone layer. *Graham flour* is the unbolted wheat meal. *Gluten flour* is the spring wheat flour after a good part of the starch has been removed.

87. Yeast Bread.—Some form of leavened bread is universally depended upon as a staple food. It is the most wholesome and, all things considered, the most economical of foods. Yeast bread is made from the staple grains, wheat and rye, because they have the properties which are needed to form a light and porous loaf. Other grains are

often combined with these to form different varieties of bread.

88. Quick Process Bread.—Bread made with a large amount of yeast, which hastens the rising and shortens the time required, is called quick process bread. The amount of yeast used regulates the time of fermentation but does not affect the quality or flavor of the bread. A yeasty odor is due to insufficient baking or over-fermentation rather than to an over amount of yeast.

Two cakes of compressed yeast to one cup of liquid is not too much for two or three hour bread. The quick process plan of bread making is a decided improvement upon the old, slow method where the dough was liable to become sour.

89. Mixing and Kneading.—The ingredients for bread should be mixed thoroughly and only enough flour should be used to make the dough stay up. The softer the dough, the better.

(1) Place the salt, sugar and fat in the mixing bowl and pour over them the scalded milk or other liquid. When this mixture is lukewarm, add the yeast rubbed to a paste in lukewarm water and mix thoroughly. Add flour enough to form a drop batter, and beat this batter until bubbles of air begin to form in the mass. Then add gradually the remainder of the flour or enough to make a dough that will form a ball around the mixing spoon and leave the sides of the bowl free from flour.

(2) After the dough has been mixed place it on a floured kneading board and knead, handling lightly, until the dough is smooth and velvety and does not stick to the hands or board.

(3) Put the dough aside in a warm place to rise. The fermentation period is the most important of all. Bread should not be allowed to rise longer than is required for it to double in bulk. If fermentation is allowed to continue too long, the dough is liable to become sour.

(4) When the dough has doubled in bulk, the gas bubbles may be removed by lightly punching the mass down

FIG. 16.—Kneading bread.

in the bowl; after which, let the dough rise again until about two-thirds its former bulk.

(5) Mould the dough into loaves by stretching, folding,

and shaping a portion to fit the baking tin. Push down the corners and sides to make an even loaf and let the loaf rise again. Moisten the loaf on top to prevent a hard crust from forming during the rising process.

90. Baking.—Bread is ready for the oven when the loaf has settled in the corners and the dough has very nearly doubled in bulk. The temperature of the oven should be about 400° F. The loaf should not begin to brown until it has been in the oven ten minutes. The pan should be turned around after three minutes baking to keep the loaf even. Sixty minutes is required for baking the average size loaf.

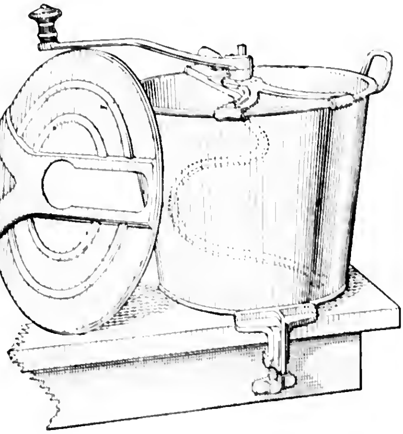
Rare or slack baked bread resulting from under baking is the worst and most frequent fault to be guarded against.

91. Effect of Ingredients on the Loaf.—Too much flour will cause a loaf to split in the middle in baking. Three cupfuls of flour to one cupful of liquid is a good proportion. A green dough (mixture not light enough when put in the oven) will have the same effect as too much flour. Sugar hurries along the action of the yeast by supplying quickly the material needed to produce carbon dioxide (CO_2).

An excess of salt retards the fermentation process. One teaspoonful of salt is sufficient for one loaf. Fat in large amounts has the same effect upon the mixture as salt. Not over one tablespoonful to a loaf should be allowed. Fat is not a necessary ingredient in well-made bread.

92. Rolls.—The various kinds of bread dough intended for rolls require a little different treatment after the first rising. The punching down to take out the gas should be omitted. Rolls should be allowed to rise until at least double the original bulk before baking. Rolls are baked in eighteen to twenty minutes and require a hotter oven than a loaf of bread will stand.

93. Bread Mixers.—A good mixer brings about the same results as hand kneading, if the correct proportion of flour and liquid is used and the mixer is turned for eight minutes. The mixer undoubtedly saves time and strength in making large quantities of bread, but for less than three loaves the hand method is easier.



Courtesy of Landers, Frary & Clark.
FIG. 17.—Bread mixer.

94. Yeast.—Yeast is a tiny, single-celled plant. The individual plants are round or oval in shape as in Fig. 18, and consist of a thin cell wall of cellulose filled with protoplasm. The dark spot or point in the cell is called the nucleus.

Under normal conditions the yeast plant develops or grows rapidly by the process known as *budding*, which is one of the simplest forms of cell reproduction.

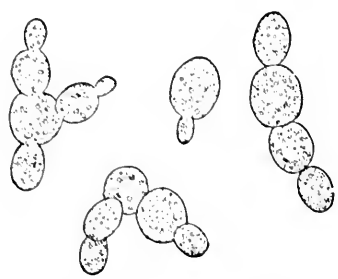
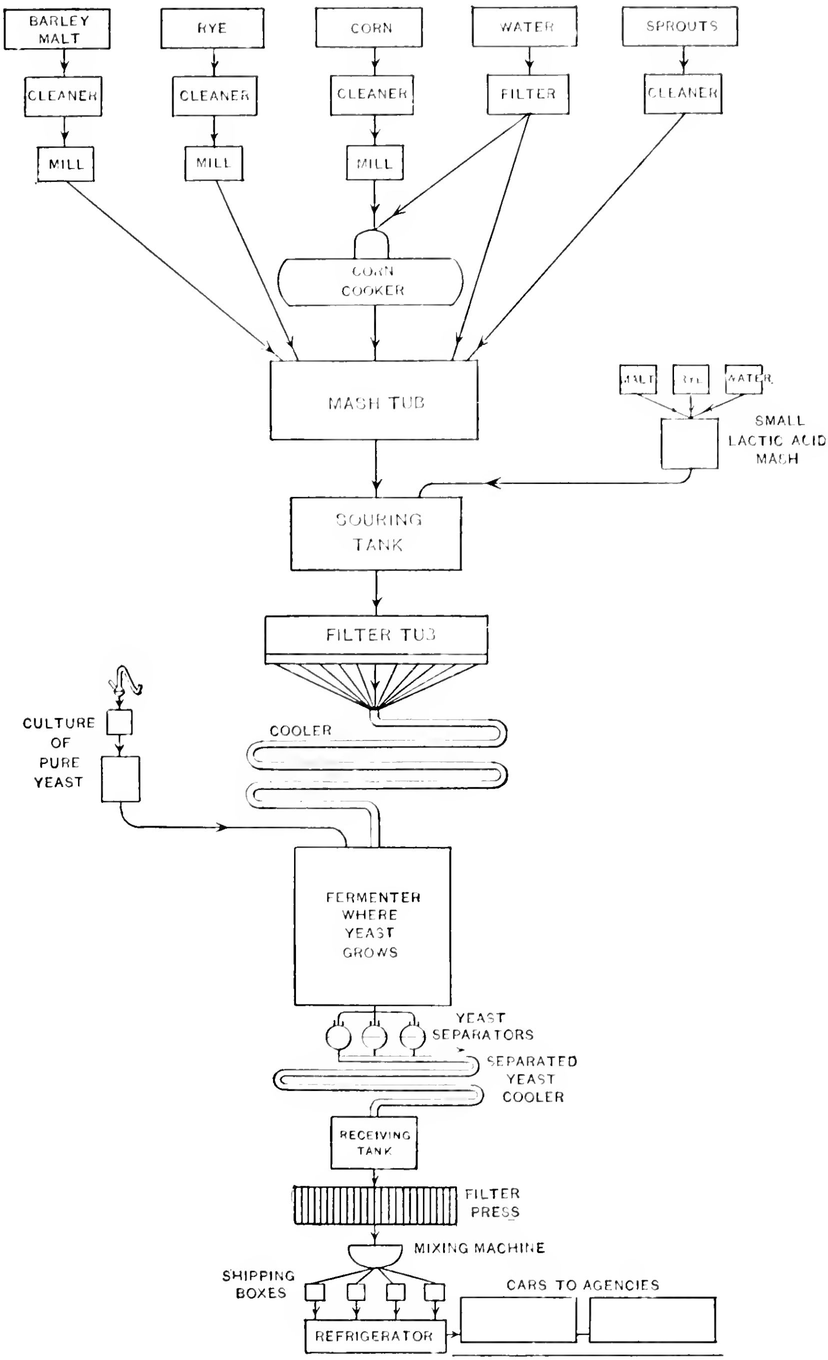


FIG. 18.—Yeast cells.

95. Sources of Yeast.—*Wild yeasts* are abundant on the skins of fruits and vegetables and in the atmosphere.

Cultivated yeast, or distillers' yeast, intended for baking purposes, is either grown in quantity for use or is a by-product of the manufacture of malt liquors. In Fig. 19 is represented the entire process of making compressed yeast from the scouring of the grains to the shipping of the finished product.

96. Commercial Yeast.—The usual forms in which yeast appears in the market are *compressed yeast, dry yeast,* and *liquid yeast.*



Courtesy of Fleischmann Co.

FIG. 19.—Manufacture of yeast.

Compressed yeast is to be preferred when it can be obtained. It has the advantage of providing a large amount of yeast in small bulk, but it will not keep for any length of time and should be fresh when used.

In dry yeast the yeast cells have been mixed with tapioca or other flour and dried before being put up in packages. Dry yeast requires a longer time to do its work and is not as effective as other forms, since many of the plants are killed by the drying process.

Liquid yeast may be made at home or bought at most bakeries. Liquid yeast is made by mixing yeast with a liquid which contains flour and sugar or other food for the yeast plant, and allowing it to stand in a warm place until the mixture is filled with yeast plants as shown by the bubbles of gas.

Compressed yeast cakes are more uniform in strength and therefore more reliable for general use than other forms of commercial yeast.

97. Functions of Yeast in Bread Making.—Since yeast plants develop best at a temperature between 75° and 90° F., the materials for bread dough should be lukewarm. When the materials have been thoroughly mixed, the mass should be kneaded until it will not stick to the hands or the board and is elastic to the touch. It should then be set aside to allow time for the growth of the yeast plants. Under proper conditions, that is, the presence of warmth, moisture, and food, the yeast plant will multiply rapidly.

Flour contains a small amount of sugar and also a ferment which is capable of changing starch into sugar. By the action of the yeast this sugar is broken down to form carbon dioxide (CO_2) and alcohol. The bubbles of gas thus formed are entangled in the dough, causing it to be spongy and light. In the oven these bubbles of gas expand and increase the size of the loaf. The heat of the oven also kills the yeast plant and drives the alcohol off as a vapor.

98. Digestibility of Bread.—The nutrients in yeast bread like those of other cereal products are digested and absorbed with relative ease and thoroughness. A light, thoroughly baked crumb is digested with less difficulty than heavy or rare baked bread. The latter tends to form a waxy mass in the stomach, which resists the action of the digestive fluids. The crust is partly dextrinized and is crisp and dry. In this state the change from dextrin to maltose is easily made by the digestive fluids.

Hot breads are less easily digested than yeast breads

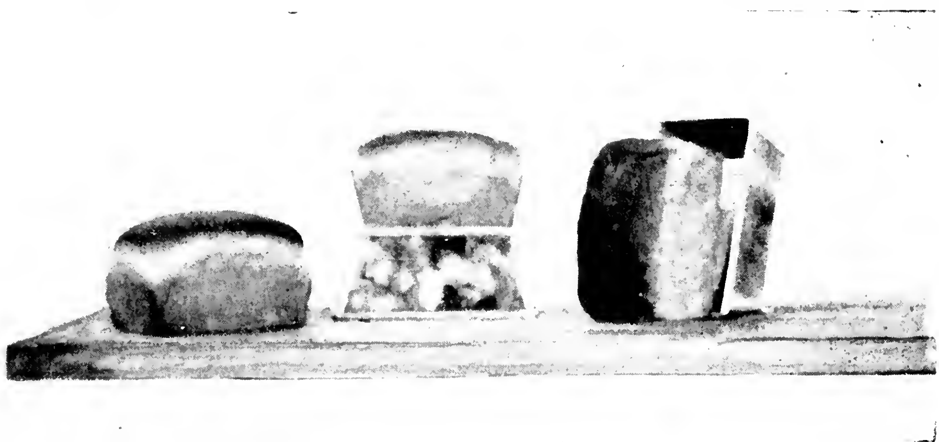


FIG. 20.—Oatmeal bread, Rye bread, and Corn bread.

because the warm crumb tends to form a waxy mass in the stomach.

99. How to Know Good Bread.—The loaf should be of medium size. (A large loaf is liable to be underdone in the center). It should be regular in shape, rounded on top and even on the sides, with a crisp, golden-brown crust.

The texture of the crumb should be fine and even. (By texture is meant the size and uniformity of the holes.) Large holes near the top of the loaf indicate that the dough was kept too warm during the fermentation process.

The color of the crumb should be white or creamy. A

gray color is due to over fermentation or to a cheap grade of flour.

The odor should be "wheaty." A yeasty odor suggests lack of sufficient baking. Underdone or slightly sour bread is unwholesome.

100. Pastry.—Pie crust, tarts, and patties belong to the stiff dough mixtures and contain a large proportion of shortening or from one-third to one-half as much as of flour.

Pastry should be light, flaky, and tender. Since pastry depends upon the air incorporated into the mixture for lightness, this property is increased by skillful handling and by keeping the ingredients at a proper temperature. The colder the ingredients the greater the expansion in baking, hence the greater the degree of lightness.

Pastry is made flaky by having the fat in rather large flakes in the flour before adding the liquid, also by spreading more fat on each time the folding and rolling process takes place. Tenderness of pastry is determined by the amount of fat used and by adding the least possible amount of moisture to make a dough. The various fats such as butter, oleomargarine, lard, lard substitutes, nut butters, and beef drippings, may be used alone or in combination for this purpose.

101. Baking Pastry.—Pies should be baked in an earthenware, granite or aluminum pan, or better still, in a Pyrex plate. The upper crust, when used, should have several openings to permit the escape of the steam generated in baking. In the case of a pie with only a lower crust it is advisable to bake the crust on the outside of the inverted pan. Prick the crust in several places with a fork before baking, to allow the confined air to escape before the heat expands it and spoils the shape of the crust.

The temperature of the oven for all kinds of pastry should be what is termed *very hot*, or from 450° F. to 500° F., until the crust begins to brown. Then the temperature

should be reduced to allow for the thorough cooking of the filling.

102. Digestibility of Pastry.—The combination of so much fat as is commonly used in pastry with flour forms a coating of fat over the starch, which retards the action of the digestive juices. Soggy pastry is not so easily digested as the crisp and flaky kind; therefore, for one-crust pies, the crust may be baked before the filling is added to prevent the crust from soaking up moisture and becoming soggy.

The deep fruit pie with an upper crust only is most desirable, since in this way the crust may be crisp and flaky. This pastry also affords a pleasing way of serving cooked fruits.

SUGGESTIONS FOR LABORATORY PRACTICE

In connection with the study of the text of the preceding chapter, make:

Bread, short and long process.
Rolls, plain and fancy.
Nut breads, raisin breads.
Whole wheat bread, corn bread, coffee cake.
Dutch apple cake.
Pie crust, tarts, patties.
One-crust pie, two-crust pie.

CHAPTER VIII

VEGETABLES

103. Definition.—In the strictest sense of the word cereals and fruits may be termed vegetables, but what is commonly known as vegetables are the plant products that have a very high water content. Those containing 70 per cent or more of water are spoken of as *succulent*.

104. Classification.—Vegetables may be classified in different ways:

(1) *As to the part of the plant used*: Seeds; roots; tubers; bulbs; stems; leaves; flowers; fruit.

(2) *As to composition*: (*a*) those containing much water; (*b*) those containing much starch; (*c*) those containing much protein.

(3) *As to flavor*: (*a*) mild in flavor; (*b*) strong in flavor.

105. Composition.—The foodstuff other than water that appears in greatest abundance in vegetables is *carbohydrate*, either in the form of starch or sugar. *Protein* is present in varying amounts in the form of globulin and vegetable casein, the latter sometimes called legumin. Comparing the protein of vegetables with that of animals, the following distinctions may be made:

(1) Vegetable protein is deficient in nucleo protein, while animal protein is rich in this material.

(2) Globulin, the form in which the protein occurs in vegetables, contains less sulphur than the animal albumin, and is insoluble in pure water though soluble in a salt solution.

(3) Vegetable protein yields, on decomposition, a much higher percentage of glutamic acid than animal protein.

Extractives are present in vegetables and belong to the class of chemical substances known as *amines*.

Mineral Matter, the presence of which adds so much to the nutritive value of many vegetables, occurs largely in the form of potash and phosphorus; but as these salts do not appear as chlorides, common salt is a welcome addition to a vegetable diet. Small amounts of citrates, phosphates, and silicates of lime are also found, and sulphur occurs in such vegetables as onions, cabbage, and the legumes.

Fat occurs in vegetables only in minute quantities and in the form of *olein*.

106. Food Value.—With the exception of a few of the starchy vegetables and the legumes, plant substances are not considered very nutritious, but they are necessary as body regulators and to give flavor, bulk and variety to the diet. They yield a certain amount of energy in the body at comparatively low cost in normal times.

107. Digestion of Vegetables.—Owing to the large amount of cellulose present in vegetables, they are more difficult of digestion than animal food, and experiments have shown that their completeness of digestion is very much less than that of animal foods. The formation of undesirable gases from the sulphur present in strong flavored vegetables causes the flatulence experienced by many people after a too liberal diet of these varieties.

108. The Selection of Vegetables.—In selecting vegetables buy those that are in season as they are then much better flavored and less expensive.

Buy by weight rather than by measure; choose firm, crisp vegetables, heavy for their size and of medium size only, as large ones are apt to be old and fibrous. See that the skin is unbroken. Earth adhering to vegetables is evidence that they have not been freshened by soaking in water.

109. Cooking Vegetables.—The changes that are to be effected by cooking are as follows:

(1) The cellular tissue is to be loosened and softened.

(2) The starch granules must absorb water and swell.

(3) Pleasant flavors are to be developed and unpleasant ones dissipated.

The method of cooking should be such as to lessen the waste as much as possible. Cooking in water, the way most commonly employed, effects a withdrawal of nutrients, especially the mineral matter—a loss which occurs to a much less extent in steaming, and not at all in baking. Keeping vegetables whole while boiling minimizes the waste.

All green vegetables, roots, and tubers should be crisp and firm before cooking. If they are not they should be allowed to stand in very cold water about one hour. All vegetables should be most carefully cleaned before cooking. Those in heads, such as cabbage, Brussels sprouts, and cauliflower, should be placed head down in cold, salted water to which a little vinegar has been added. This will draw out any animal life that may be present in them.

All vegetables except the legumes are best cooked by putting into rapidly boiling water and keeping them at this temperature until the vegetables are tender. The cover of the saucepan should be partly off to allow for ventilation and the evaporation of the disagreeable volatile gases developed by the heat. Over-cooking is to be avoided, as it destroys the chlorophyl and other coloring matter and injures the substances which give the pleasant flavors.

The practice of adding bicarbonate of soda to the water in which vegetables are to be cooked is no longer advised. It has been found by experiment that cooking in an alkaline solution dissolves some of the vitamines, thereby decreasing the nutritive value of the vegetables.

110. Blanching Vegetables.—Blanching is supposed to improve the flavor by removing the strong, acrid taste of some vegetables, to harden the tissue, and to set the color. This is done by dipping the vegetables, which have been thoroughly cleaned and placed either in cheese-cloth or in a

wire basket, into rapidly boiling water, covering and keeping at this point from five to ten minutes. Drain, and if the vegetables are not to be used for canning (in which case they are plunged immediately into cold water), put them into a saucepan with as little water as possible, partly cover and allow to cook gently until tender, when most of the water should have evaporated. Salt, pepper, and butter should be added before serving.

111. Preserving Vegetables.—Vegetables are preserved in a variety of ways, although canning and drying are perhaps the most popular. These processes will be treated at greater length in a separate chapter. Simply packing fresh vegetables between layers of salt will preserve them. Salt with the addition of vinegar is used in pickling. Commercial cold storage has done much to conserve the surplus in vegetables as in other foods, and is of course effective in checking bacterial growth. Preserving vegetables by the use of such preservatives as borates, benzoates, etc., is to be condemned. The so-called winter vegetables such as turnips, cabbage, onions, carrots, parsnips and beets may be kept in good condition by being buried or stored in a cool place.

FIG. 21.—Lentils. (Farmer's Bulletin 121.)

112. Legumes.—The legumes belong to the pulse family. They are the fruit of the plant and are usually in

the shape of a pod. There are many kinds, but those used as vegetables are peas, beans, and lentils. The unripe peas and beans and the edible pods of the latter contain much water and are classed as succulent vegetables. While they are not as rich in nutrients as the matured ones, they are

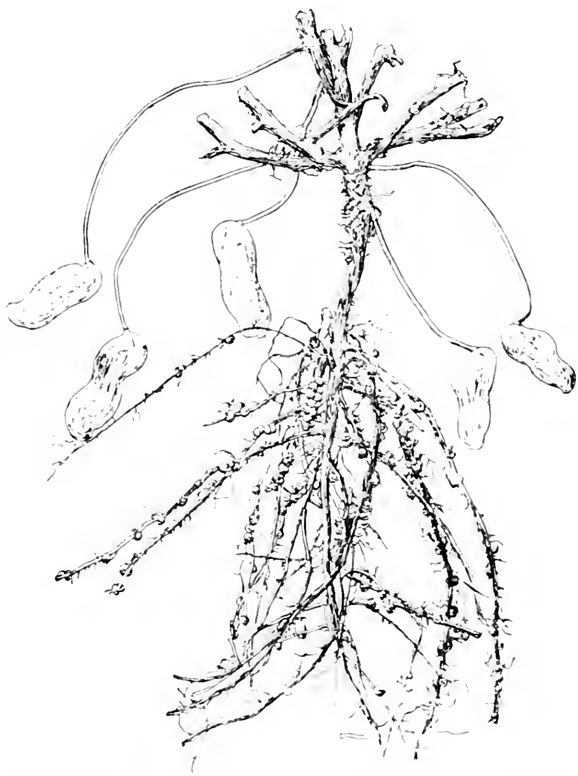


FIG. 22.—Peanut vine showing nodules on the roots. (Bulletin 121.)

more delicate in flavor and more easily digested. The lentil is never eaten except when fully ripe.

113. Food Value of Legumes.—The legumes, except in war times, are a particularly cheap source of protein or nitrogen to the body. They are the only plants that can make use of the nitrogen of the air to build their own tissue, and for this purpose their roots are furnished with nodules thickly populated by nitrogen-fixing bacteria. The dried

legumes are fully matured and, while deficient in flavor they contain a high percentage of protein. In cases where they can be digested without too much difficulty the legumes may be used as a substitute for the more expensive animal foods.

114. Cooking Legumes.—The green legumes are cooked in the same way as other fresh vegetables; but the way in which the dried ones are cooked greatly influences their digestibility. Dried legumes should be cleaned, then soaked over night in cold water, and in the morning cooked in this same water until tender. Making the legumes into a puree renders them more available as a source of nourishment. It separates the more digestible pulp from the skin. The digestibility of legumes is increased if they are eaten in combination with other food rather than alone.

115. Soy Beans.—The soy bean, Fig. 23, which is sometimes spoken of as the Togo bean, has been used as food in China and Japan since ancient times; but in this country its use as such is just beginning.

Up to the present time it has served only as a fertilizer, as food for hogs, or as a source of oil to be used as a substitute for more expensive oils.

Composition.—Like most legumes the soy bean is very rich in protein. Compared with the cereals it contains three times as much protein as wheat or rye flour, and five times as much as corn flour. The amount of fat present in the soy bean is ten times as much as is present in any cereal. It is deficient in carbohydrates.

Appearance.—In appearance the soy bean is round and yellow, somewhat similar to the garden pea. There are two hundred varieties, but it is the yellow-seeded variety which is best for food.

Cooking.—The soy bean may be cooked in a variety of ways, and may be combined to advantage with many other foods such as rice, cheese, tomatoes, and corn. It may be soaked over night and baked the same as the navy bean, but without the addition of fat of any kind.

Courtesy [illegible] Department

Fig. 23.—Soy beans

The plant to the left inoculated; the one to the right uninoculated. From McCall's "Studies of Crops"

116. Tubers.—A tuber is a short, fleshy, underground stem. The common edible tubers include white potatoes Jerusalem artichokes, and sweet potatoes.

While *white potatoes* are rich in starch and are, therefore, a source of energy to the body, they are chiefly valuable for their antiscorbutic properties, due to the nature of the mineral matter present. Very new and very old potatoes contain less starch and more soluble sugar, which accounts for their lack of mealiness when cooked. After potatoes begin to sprout, the starch content is changed to glucose by a ferment present in them.

Jersualem artichokes contain no starch, and so resemble the turnip rather than the potato. They do contain a small amount of sugar and another form of carbohydrate known as *inulin.*

Sweet potatoes are about the same in composition as the white, containing a little more sugar and being somewhat laxative.

117. The Dasheen.—This comparatively little known vegetable is of the starchy variety and rather closely resembles the potato (Fig. 24), though it is more delicate in flavor and contains less water. After cooking, the flesh becomes gray or violet.

Any method of cooking which may be applied to the potato may likewise be applied to the dasheen. If scraped before cooking, it should be handled under water to which sal-soda has been added (one teaspoon to one quart of water). This is done to prevent the juice from the outer layer from exerting an irritating effect upon the hands.

118. Roots.—The roots most commonly used as foods are beets, radishes, turnips, carrots, salsify, parsnips and celeriac.

Beets, carrots and turnips, when used as summer vegetables, are the quickly grown variety and are gathered while small. When intended for winter use, they must be allowed to mature or they cannot be successfully stored.

Celeriac is a variety of the familiar celery but is cultivated for its turnip-like root, rather than for its stalk.

119. Bulbs.—The underground leaf-buds of certain plants are known as bulbs. Onions are the most generally used of this type, but others used more sparingly and for flavor only, are garlic, leek, shallot and chives.

120. Leaves, Stems, and Shoots.—The edible portions of cabbage, lettuce, celery, asparagus, and spinach are the

Fig. 24.—The Dasheen.
(Journal of Home Economics.)

leaves, stems or shoots of the plants. While the food value of these vegetables is not high, they are refreshing and a pleasant source of mineral matter. Contrary to custom, leaf vegetables should be cooked in as little water as possible and the water saved as it has been found to contain valuable vitamines.

121. Fruit.—The seed-bearing part of a plant is called the fruit. The common vegetables used as foods, which are known to the botanist as the fruits of the plants, are toma-

FIG. 25.—Digging celery with a spading fork.
(From Yeaw's Market Gardening.)

toes, okra, squash, pumpkin, cucumber, egg plant and peppers.

122. Flower Buds.—Among the food plants of which the parts eaten are the flower buds may be mentioned: cauliflower, broccoli and French artichokes.

Broccoli is a variety of cabbage. It resembles the cauliflower but has a taller stem.

French artichokes are large flower buds; the buds must be used before they are open. The edible parts are the thickened portion at the base of the scales and the part to which the leaf-like scales are attached.

Brussels sprouts are a variety of cabbage having about the same composition as the cabbage.

Kohl-rabi is very similar to the turnip in appearance and flavor.

Okra is a plant much cultivated in the South for its young, mucilagenous pods. It has very little food value and is generally used for flavoring soups. In localities where it is grown the very young seeds are sometimes cooked in the same way as green peas. The tender pods may be boiled and served as salad.

123. Green Vegetables.—The so-called green vegetables, or salad plants, are those usually eaten without cooking. Lettuce is the best example and most widely used of these, but endive, cress, mint, green peppers, celery, cucumbers, and escarole are much used.

Green vegetables are composed largely of water (90 per cent or more) and cellulose. Their most valuable constituent, infinitesimal though it may be in amount, is mineral matter. This exists largely in the form of potassium salts, though small amounts of iron are also present and certain substances which impart an agreeable flavor.

124. Digestion and Food Value of Green Vegetables.—Green vegetables are not easy of digestion except when young. With age the amount of cellulose increases, making them tough and stringy. Owing to the amount of water

FIG. 26.—Brussels sprouts.
(From Yeaw's Market Gardening)

they contain, green vegetables must be eaten while fresh, as they wilt easily, due to the evaporation of some of this water.

None of these salad plants are of high nutritive value, but they are cooling, antiscorbutic, and gently laxative. Because of their low nutritive value they may be eaten in addition to the protein and fuel foods without unduly increasing the total amount of food consumed. This property makes them very useful in the limited diet of those who are reducing.

Whether green vegetables are to be cooked or not, they must be very carefully cleaned by soaking in very cold, salted water and removing all decayed parts. Some authorities advise dipping in boiling water for one minute in order to kill any living organisms that may be present.

125. Lettuce, Roumaine and Escarole.—These vegetables are cultivated for their pleasant flavor and are in the market all the year round as they can be grown successfully under glass.

SUGGESTIONS FOR LABORATORY PRACTICE

In connection with the study of the text of the preceding chapter:

Cook potatoes, tomatoes, carrots, cabbage, onions, or any vegetable in season.

CHAPTER IX

FRUITS

126. Definition.—In a restricted sense all seed-bearing portions of plants are termed fruits, but in the usual sense the term *fruit* is used to indicate only those seed-bearing portions containing a large amount of water and a small amount of dry matter in the form of sugar and non-nitrogenous compounds. Any food, for example, rhubarb, which takes the same place in the diet, may be classed as a fruit.

127. Composition.—Fruits, like vegetables, contain a large amount of water. Some authorities go so far as to classify them according to their water content, those having more than 80 per cent of water being classed as "flavor fruits."

Another more common classification is as: stone fruits; pome fruits; and berries.

The most important solid nutrient of fruit is *carbohydrate*. This occurs as a form of sugar; cane sugar, grape sugar (glucose), or fruit sugar (levulose). The last two sugars are usually found together in about equal proportions and are sometimes referred to as "invert sugar."

Fat, except in the case of such fruits as the olive and the avacado or alligator pear, exists in fruits in such small quantities as to be negligible.

Mineral matter, a most important constituent of all fruit, is found in the form of potassium salts, phosphorus, lime, and iron. Acids are present in varying amounts, from 1 to 2 per cent in apples to 7 per cent in lemons. The most common fruit acids are malic, citric, and tartaric.

Protein is found in fruits only in very small amounts.

128. Digestibility.—The ease with which fruits are digested depends upon the nature of the fruit and the degree of ripeness and freshness. Unripe fruits are indigestible because of the large amount of cellulose present, and because the large amount of acid acts as an irritant to the digestive organs. Overripe fruits are indigestible because of the fermentation products which have begun to form.

129. Food Value.—While fruits are not a source of much nourishment to the body, they yield energy and are of inestimable value as body-regulators. Their acids stimulate the flow of the digestive juices, and because of the organic potassium compound which they contain, fruits when oxidized in the body, leave basic or alkaline salts which help to neutralize the undesirable acids that are a necessary accompaniment of all body metabolism.

Fruits containing malic or citric acid serve as a laxative when taken before or at the beginning of breakfast. Fruits tend to lessen intestinal putrefaction, because of their fibrous nature which stimulates peristalsis, and because they furnish a condition unfavorable to the growth of intestinal bacteria.

130. Selecting Fruit.—Fruits owe much of their popularity to their pleasant flavor. This flavor is due to ethereal substances that, as their name implies, may easily be lost. Therefore, fruits that are not perfectly fresh show the fact by loss of flavor as well as by loss of color. As fruits deteriorate, their coloring matter undergoes various chemical changes which give the faded, dull appearance noticeable in fruit of inferior quality. Fruit in prime condition should be firm and heavy in proportion to its size, and the skin should be unbroken.

131. Preparation and Cooking.—Because of the great improvement in culture, storage facilities, and transportation, the season for fresh fruit has been greatly lengthened.

Moreover, commercially dried fruit has come into greater use, so that fruit of some kind is now considered a necessary part of the daily ration.

As so much fruit is eaten uncooked, great care should be observed in preparing it; otherwise it may be a means of conveying harmful organisms to the body. The popular idea that fruit must not be washed no longer prevails. It should be carefully washed, but only just before using, as most fruit is apt to mould. Fruits may be cooked in various ways, and in some cases the digestibility is increased by so doing, but the fact must be borne in mind that cooking often injures the flavor and changes the nature of the salts and acids present. Fruit discolors when pared and exposed to the air. This is due to the action of the oxydases (natural ferments) in the fruit, upon the tannin in the fruit, in the presence of air.

The utensils used in cooking fruit must be of a material not easily acted upon by acids. A silver knife should always be used in preparing fruits.

132. Storing.—Fruit to be stored must be in perfect condition, firm and free from the slightest bruise. It may be packed in barrels and kept in a clean cool place, not dry enough to cause the fruit to shrivel or moist enough to cause fermentation. The store room should be well ventilated, as fruits quickly absorb odors. Fruits keep best when wrapped individually in tissue paper.

133. Preserving.—Fruits may be preserved by canning, drying, pickling and candying, and in the form of jellies, jams and marmalades. These processes are considered under a separate heading.

134. Dried Fruits.—Since the drying of fruit has become such an important industry on our western coast, such fruits as peaches, apricots, prunes, figs, and raisins are now easily obtained at all times, and are found to be cheaper in proportion to the solids they contain than are the fresh fruits.

When properly cooked, dried fruits are a palatable and useful addition to the diet. They should be thoroughly cleaned, allowed to remain over night in sufficient water to cover them, then cooked in the same water until tender, with little or no sugar. Prunes are best flavored when cooked without sugar.

135. Jellies, Jams, and Marmalades.—These methods of preserving are particularly applicable to fruits and fruit juices. Their solidity and the presence of sugar in fairly large amounts, render them impervious to bacterial action. Their solidity is due to the existence in fruit of a carbohydrate substance called *pectin*, which closely resembles and has many of the properties of starch.

136. Nuts.—The increasing popularity of nuts as a part of the diet is probably due to a growing appreciation of their food value and appetizing qualities, as well as to a wider knowledge of the various ways in which they may be used to advantage.

Composition.—Owing to their deficiency in water, nuts offer a very concentrated form of nourishment. They are a rich source of proteins, some (the peanut for example) yielding as high as 29.8 per cent of this foodstuff. In the analysis of thirteen different varieties, half the edible portion of the nut consisted of fat or oil. Carbohydrate does not appear to any extent except in the chestnut. Mineral matter is an important constituent of all nuts, walnuts and almonds being especially rich in phosphorus.

Flavor.—The flavor of nuts is largely dependent upon the nature of the oil present, though in some instances special flavoring substances are also present. This oil becomes rancid quickly and gives the intensely disagreeable taste to spoiled nuts.

Digestibility.—The difficulty experienced by some in digesting nuts is probably due to improper mastication and to the indiscriminate use of nuts at such times as the end of a meal or late at night. To their concentrated form

also may be attributed some of the difficulty in their digestion. This is obviated if nuts are eaten at the proper time and in proper relation to the rest of the diet. Experiments in the use of almonds, peanuts, pecans, and walnuts have brought out the fact that, in a fruit and nut diet, the nut protein was digested quite as easily, though not quite so completely, as the protein of milk.

137. The Use of Salt with Nuts.—While the addition of salt to nuts may improve their flavor, no proof exists that it in any way facilitates their digestion, as it is so popularly supposed to do.

138. Food Value of Nuts.—Because of the composition of nuts, vegetarians have been in the habit of using them in their diet as a source of protein and fat. At the present time many others are gradually being forced to adopt the same plan, owing to the constantly increasing cost of animal food. In the use of nuts, however, satisfactory results can be obtained only by a thoughtful arrangement of the menu. The nuts should be made to take a definite place in the meal rather than to supplement an otherwise sufficient one. Because of their concentrated nature they should be combined with foods of a bulky type, such as vegetables, fruits, etc. Those of high protein and fat content should be combined with the various carbohydrate foods, while the carbohydrate-containing chestnut may be advantageously used with milk, meat, and eggs. Nut butter, notably peanut, is very digestible owing to the fine division of the nut substance, and is in a form often relished by people opposed to nuts in other forms. Peanut oil may be substituted for olive oil in dressing salads.

139. Use of Nuts in Cooking.—Nuts are more often eaten raw than cooked, though some, like the peanut and chestnut, are much improved in flavor by roasting. Nuts are now coming to be used very often in the making of soups, stuffings, salads, breads, cakes, etc.

140. Storing Nuts.—Nuts should be stored in a dry place,

because dampness quickly makes them rancid. Shelled nuts must be carefully protected from insects.

EXPERIMENTS

Experiment 1. The Test for Pectin.—Add two teaspoonfuls of alcohol to two teaspoonfuls of cooked fruit juice. Mix thoroughly. The formation of a gelatinous mass indicates the presence of pectin.

Experiment 2. The Test for Tannin.—Extract the juice from unripe fruit, filter and add ferric chloride. A black color indicates the presence of tannin.

SUGGESTIONS FOR LABORATORY PRACTICE

In connection with the study of the text of the preceding chapter:

Cook fruits in various ways, as boiling, baking, scalloping, stewing.

CHAPTER X

FATS AND OILS

141. Composition.—Fats and oils are a combination of the elements carbon, hydrogen, and oxygen. The oxygen is less in proportion to the carbon than in the carbohydrates, which accounts for the greater yield of energy by fats and oils. The fats and the oils were the first of the organic foodstuffs to have their composition determined. Upon study it was found that all fats are formed by the chemical union of fatty acids and glycerol or glycerin. The kind of fat depends upon the fatty acids in the combination. The common fatty acids, beginning with that having the lowest melting-point, are butyric, oleic, palmitic, and stearic.

Glycerol has the power to unite with one, two, or three fatty acids to form simple or complex glycerides.

142. Properties.—As to physical properties the fats and oils differ in that fats are solid at ordinary temperature while oils are the reverse or liquid at ordinary temperatures. The chemical difference in the various fats and oils depends upon the fatty acid predominating. In *tallow* and *lard* the glycerides are mainly stearin and palmatin with only a small percentage of olein, but in the softer fats and oils, olein predominates.

In *butter* the glyceride is chiefly butyrin. Small amounts of various other glycerides are found in combination.

Fats have a varying melting-point because they are mixtures rather than pure glycerides. Hard or animal fats have the highest melting-points and oils or liquid fats a low melting-point.

143. Function of Fats in Nutrition.—Fats are broken down in normal metabolism and yield twice as many calories of heat per gram as carbohydrate and protein. The primary use of fats in the body is as a fuel or *heat producer*, only excess amounts being stored as fat in the body tissues.

As a building material fat is changed into the composition of the protoplasm of the cells or is stored as body fat in certain parts of the body. The tissues around the liver and the abdomen are, as a rule, the first to store this excess fat.

Some fats hold in solution substances that are essential in normal nutrition and thus serve as body regulators. The fat of milk, of egg yolk, and to some extent the soft fat of beef, belong to this class. A deficiency of these foods in the diet will be shown in the slow growth and development of the body.

144. Digestibility of Fats.—The fats and oils are changed back to fatty acids and glycerin in the digestive tract, and, as such, are absorbed through the intestinal walls into the lymphatics. From there they go into the general circulation of the blood and are found again as a fat. The reuniting of the parts takes place at the time of absorption into the blood stream.

It is now a well established fact that the fineness of the emulsion into which a fat is changed determines the length of time and ease of the process of digestion and assimilation.

The finely emulsified fats found in milk and eggs may have the digestive process completed in the stomach. Those forming a different emulsion and having a higher melting-point are not changed until they reach the intestines and come in contact with the bile salts and other juices which act upon the fats.

There is some difference of opinion as to the extent of the influence of fats in the process of the digestion of other foods. The fact that fats are unaltered in the mouth, except for being melted or divided into fine particles, that

only certain kinds are modified in the stomach, and that others, by coating the mucous lining of the stomach with a film of fat, interfere with the action of the gastric juice, leads to the conclusion that a meal rich in fat will be slow of digestion. Therefore, in summarizing, it may be said that the digestiblity of a fat depends upon its melting-point and the fineness of the emulsion in which it occurs.

145. Sources of Fats.—Fats are obtained from both animal and vegetable sources. The principal animal fats are cream, butter, egg yolk, fat of beef, mutton, pork and bacon, bone marrow, chicken fat, and cod liver oil.

Vegetable fats are those derived from the seeds of plants, as olive oil, cottonseed oil, corn oil, and nut oils.

Butter and cream are the most highly prized of the animal fats because of the ease with which they are digested and because they supply important vitamines, fat-soluble substances. They are expensive foods and often, where cost must be considered, it is necessary to substitute some less expensive fat for ordinary use. Butterine or oleomargarine may be used in place of butter, except for table use. Butter contains 84 per cent of fat, about 12 per cent to 13 per cent of water, a little curd, and nearly 2 per cent of salt.

Butterine and oleomargarine are made from suet and cottonseed oil churned together in milk, or milk and cream, which impart a small amount of the growth-stimulating substances found in butter. The materials used and the process of manufacture are usually absolutely clean and wholesome and the product is then to be preferred to renovated butter or even fresh dairy butter made under undesirable conditions.

Bacon fat ranks with butter and cream in the matter of expense and should be saved and utilized in the cooking of other foods.

Lard is the fat of pork rendered and refined. The best grade is called *leaf lard,* and is extracted from the solid

fatty tissue around the kidneys. Other grades are the rendered fat of different parts of the animal.

The various *lard substitutes* or lard compounds sold under such trade names as *Crisco, Snow Drift*, etc., are chiefly mixtures of beef fat and cottonseed oil.

Beef suet is the hard, kidney fat of the animal and is used in making rich puddings and mince pies. It may be melted with a fat of a lower melting-point to form a medium fat suitable for other cooking purposes.

Mutton fat or mutton tallow, on account of its strong odor and flavor, is not combined with other fats for household use.

Bone marrow, the fat found in the shin bones of the beef animal, is a fat of low melting-point and, consequently, is easy of digestion. It gives a richness and flavor to soup stock made from a marrow bone which is not found in other stock. Its chief value, however, is that it contains vitamines having a remarkable stimulating influence upon the body.

Chicken fat is an excellent substitute for butter in cake making. As a matter of fact, it may be used for any purpose for which butter is used except on bread.

Cod liver oil is a well known fat recommended as a body building medicine, and probably owes its beneficial action to the presence of fat-soluble substances of value in the building and repair of the body tissues.

Olive oil is manufactured from ripe olives. The fruit is gathered just before it turns black, because at this stage it contains the maximum amount of oil. To obtain the oil, the olives are first crushed and the oil is then extracted by pressure. The first oil that flows under slight pressure is considered of superior quality, and that extracted by greater pressure is of a second grade. The dark color is removed by allowing the oil to stand until the sediment settles and then filtering it.

The flavor of olive oil is dependent upon the variety

and ripeness of the olives used and upon the temperature and amount of pressure used at the time it is obtained.

Cottonseed oil is used in combination with other fats and as an adulterant of and substitute for olive oil. It is undoubtedly the most important of the vegetable fats now in use. The oil which is extracted from the seeds by pressure is refined by a secret process which removes the characteristic flavor. The cost of the best quality of cottonseed oil is less than one-half that of a medium grade of olive oil and the value is essentially the same since both contain practically 100 per cent of fat.

Many of the common nuts furnish an edible *nut butter or oil* of low melting-point, which is much valued as a fuel food.

146. Cooking in Fats.—Fats, when heated to a high temperature, slowly decompose, giving off *acrolein,* a substance having a disagreeable odor and an irritating effect upon the mucous linings of the body.

Deep fat frying, when properly done, is not so undesirable as formerly believed by many people. If the fat is not heated to the extreme temperature at which it decomposes so that the food does not carry with it this objectionable acrolein, there is little to be said against fried food for the adult having a normal digestion. It is the abuse of this method rather than its use that should be condemned. In selecting a medium for frying, it is important to consider the temperature at which decomposition takes place. Olive oil, considered by many people as the best medium for frying, may be heated above 600° F. before burning. Crisco and some of the other compounds will bear much more heat or about 800° F. Cottolene has a burning point of 450° F. and lard of about 400° F. Butter has the lowest burning-point or about 350° F. and is, therefore, not desirable as a fat for frying.

The temperature of the fat suitable for this method of cooking ranges from 400° F. to 450° F. according to the

nature of the article to be cooked. A piece of bread one inch square will turn a golden brown in one minute in a fat that is at the right temperature for frying an uncooked mixture such as doughnuts or fritters, and in forty seconds when the fat is at the right temperature for a cooked mixture such as croquettes. Foods likely to absorb fat during this process of cooking should be protected by a covering of egg and bread crumbs. The egg coagulates readily and with the crumbs forms a crust which prevents the soaking up of fat provided the temperature of the fat is sufficiently high.

147. Preparation of Fats.—Many of the animal fats may be utilized in combination with other foods. For example, suet drippings and other hard fats may be tried out, clarified, and mixed with cottonseed oil or any fat having a low melting-point. This produces a mixture having a medium melting-point which may be used in making cakes and pastry. It may be employed also as a medium for deep fat frying.

At this time when great stress is placed upon the elimination of waste in the household the use of fats hitherto unused is extremely important.

148. To Clarify Fat.—Fats may be clarified by adding slices of raw potato to the fat and heating slowly until it stops foaming, then cooling and straining through a cloth. If the fat is small in quantity, add a considerable amount of boiling water, stir vigorously, and allow to cool. When the fat has hardened, remove it in a cake from the top of the water. A sediment will be found on the bottom of the cake of fat which may be removed with a knife.

149. Rendering Fats.—To render fat remove the outside skin and lean from fat meat and cut the fat in small pieces. Place the fat in a kettle and cover it with cold water. Cook slowly in an uncovered vessel until the water is all evaporated, then reduce the heat and let the fat slowly try out. When the fat is quiet and the pieces of fatty tissue are settled at the bottom of the kettle, cool, strain through a cloth and allow to harden.

EXPERIMENTS

Experiment 1. Solubility of Oil in Water.—Pour a teaspoonful of oil into a test tube and add the same quantity of water. Shake well and then examine. Set aside for a while and examine again. Is oil soluble in water?

Experiment 2. Spoon Test for Butter.—Heat a piece of butter about the size of a bean in a tablespoon, stirring with a toothpick. Note the amount of foam produced, and the noise made in boiling. Genuine butter makes very little noise on boiling, but produces much foam. Renovated butter boils noisily, but it produces little foam, while oleomargarine boils with more or less sputtering, but produces no foam.

SUGGESTIONS FOR LABORATORY PRACTICE

In connection with the study of the text of the preceding chapter:

Render and clarify fats.

Fry in deep fat croquettes, fritters, and French fried potatoes.

Prepare salad dressings: French, boiled and mayonnaise.

CHAPTER XI

MILK

150. Value As Food.—Milk contains all five of the foodstuffs and on this account is sometimes spoken of as a perfect food. It is a perfect food only for an infant, for while it contains all of the nutrients required by the body, these are not in the right proportion for the nourishment of an adult. Owing to the large percentage of water which it contains, it is too bulky; to get the proper amount of other nutrients a man would have to consume at least eight pints a day.

TABLE VII.—AVERAGE COMPOSITION OF MILK

Protein	3.3%
Fat	4.0%
Carbohydrates	5.0%
Mineral matter	0.7%
Water	87.0%

Milk in normal times is one of the cheapest sources of animal protein; the amount of protein in one quart of milk being equal to that in one pound of beef or in eight or nine eggs. Milk depends largely for its fuel value on the amount of fat present. Milk with only four per cent of fat will yield 675 calories per quart; from 97 to 98 per cent of milk protein is said to be absorbed. The fact that milk has no waste and may be used without preparation should make it a very valuable part of the diet. That it is a tissue building and growth producing food makes it especially valuable in the feeding of children.

151. Composition.—Milk varies greatly in composition; much depends upon the breed, age, and food of the cow.

The amount of fat present is a good indication of the quality for milk rich in cream is always found to be correspondingly rich in protein and sugar. Usually the amount of fat sets the price standard commercially, and most states require milk to contain 4 per cent of fat.

Protein in milk is represented by *casein* and *albumin*. The casein is different from the albumin in that it contains phosphorus and sulphur. Casein is coagulated by acid and rennet. The action of acid is called "curdling," and that of rennet, "clotting." In curdling, the casein is simply precipitated without undergoing any chemical change; this is supposed to be due to the fact that acid separates the lime salts from the casein, and then it becomes insoluble.

TABLE VIII.—COMPARATIVE FOOD VALUE OF MILK AND THE EDIBLE PORTION OF OTHER COMMON FOODS

	Refuse.	Water.	Protein.	Fat.	Carbohydrates.	Minerals.	Food Value, Calories.
Whole milk, 1 lb..	0.00	0.87	0.03	0.04	0.05	0.01	325
Skim milk, 1 lb...	0.00	0.90	0.04	....	0.05	0.01	170
Cheese, 1 lb......	0.00	0.34	0.26	0.34	0.04	....	1965
Butter, 1 lb......	0.00	0.11	0.01	0.85	....	0.03	3605
Beef (round), 1 lb.	0.08	0.61	0.18	0.12	....	0.01	870
Pork (ham), 1 lb..	0.14	0.35	0.13	0.34	....	0.04	1655
Wheat bread, 1 lb.	0.00	0.35	0.10	0.01	0.53	0.01	1205
Oatmeal, 1 lb....	0.00	0.07	0.16	0.07	0.68	0.02	1860
Dried beans, 1 lb.	0.00	0.13	0.22	0.02	0.59	0.04	1590
Potatoes, 1 lb....	0.15	0.67	0.02	....	0.15	0.01	325

Albumin is present in very small quantities and is coagulated very slowly when milk is heated.

Fat is represented by cream which is distributed through the fresh milk in the form of globules, but these, being lighter than water, rise to the surface as the milk stands. Commercially speaking, fat is the most important constituent of the milk as from it butter is made.

Carbohydrate is represented in milk by the milk sugar or lactose: this is somewhat different from cane sugar, as it is not so sweet and does not easily ferment. It is affected by certain bacteria that split it and produce lactic acid.

Mineral matter is represented by phosphorus and calcium compounds in relatively large quantities, and a small amount of iron.

152. Digestibility. When milk enters the stomach, it clots through the action of the rennin present in the stomach. That it is not curdled through the action of the gastric juice, which is acid, is probably due to the fact that the alkaline salts of the milk neutralize the acid first, and so gives the rennin time in which to act. This clot in some cases becomes very tough and leathery, and on this account many people find milk difficult of digestion. The addition of lime water or an aerated water to the milk is said to be efficacious in preventing the formation of this tough curd. If for any reason milk is not digested in the stomach, it is found to be readily digested in the small intestine. Milk is constipating when used alone, because the residue left from it is not sufficiently bulky to produce peristalsis. Milk does not yield uric acid in the body or produce intestinal putrefaction.

153. The Care of Milk. The greatest care should be exercised in handling milk; absolute cleanliness and a low temperature are essential, because milk furnishes one of the best mediums for the growth of bacteria. A temperature of 50 degrees is desirable. Milk should be bottled at the place of production and kept in contact with ice until it reaches the consumer. Old milk should never be mixed with new, and if kept at 50 degrees should remain sweet at least twelve hours.

154. Skim Milk.—Milk from which the fat or cream has been removed is called skim milk. The amount of fat which remains depends upon the method of creaming. With

the exception of fat, skim milk contains all the constituents of whole milk, and may be used advantageously.

155. Sour Milk.—When milk stands too long or in a warm place, the bacteria in it rapidly multiply and change the sugar, or lactose, into an acid called *lactic acid.* This acid acts on the casein, hardening it and giving to sour milk its characteristic curdled appearance. As the greater portion of lactic acid is formed during the first twenty-four hours and the process is generally completed in forty-eight hours, it follows that sour milk should be made use of without further delay.

156. Certified Milk.—Certified milk is milk that has been produced under the very best sanitary conditions and under the supervision of a medical milk commission. Its cost is about twice that of ordinary milk because of the extra expense in producing it. It forms less than one per cent of the milk of commerce.

157. Pasteurized Milk.—Pasteurized milk is milk that has been heated to a temperature of 140° F. or 145° F., kept at this temperature twenty to thirty minutes, and then cooled rapidly. This process does not kill all bacteria, but is supposed to destroy bacteria of diseases transmissible by milk, such as tuberculosis, typhoid fever, etc.

158. Sterilized Milk.—This is milk that has been raised to a temperature sufficiently high to kill all active bacteria present. In the light of the latest scientific investigations there is no difference in the nutritive value of boiled and unboiled milk.

159. Condensed Milk.—Milk from which a large proportion of the water has been evaporated is known as condensed milk. The unsweetened or commonly called "evaporated" milk has a creamy consistency, is sold in bottles, and must be used within a few days. The sweetened has a large amount of cane sugar, 40 per cent, and being sealed in tin cans may be kept indefinitely.

160. Milk Powder.—By milk powder is meant milk that

has been evaporated to a fine white powder. When water is added, the product resembles ordinary milk and may be used in cooking.

161. Modified Milk.—Modified milk is cow's milk which is designed to replace mother's milk in the feeding of infants. As the proportion of the foodstuffs differ in the two milks, the cow's milk containing more protein and less sugar than human milk, this difference is remedied by adding to the cow's milk lactose, or some digestible carbohydrates such as rice flour or arrowroot, and a certain amount of sterile water. The casein of cow's milk is harder to digest on account of the toughness of the curd formed.

The custom of adding lime water to milk with the mistaken idea of increasing the alkalinity of the milk no longer holds good, as it has been found that lime water decreases rather than increases this alkalinity, because of the precipitation of the calcium phosphate.

162. Malted Milk.—Malted milk is a mixture of desiccated milk, wheat flour, barley malt, and bicarbonate of soda. This milk is sometimes found to be more easy of digestion than ordinary milk; this is due to the fact that the casein, like that of condensed milk, clots very loosely or not at all.

163. Milk in Cooking.—The addition of milk to any recipe greatly increases the nutritive value. Bread made with milk is much higher in food value than that made with water. Milk soups are a great source of nitrogenous material in a diet. White sauces are not only useful nutritively but economically in utilizing left over food. Simple desserts made principally of milk are highly recommended dietetically.

164. Butter.—Butter is made from the cream of milk. The practice of pasteurizing the cream before churning is to be recommended, not only to eliminate all danger of disease, but to get rid of the bacteria present so that bacteria that will produce only the desired acid fermentation may

be added. The pleasant flavor and aroma of butter is due to this fermentation.

TABLE IX.—COMPOSITION OF BUTTER

Fat	84.0%
Casein	1.30%
Moisture	12.73%
Salts	1.97%

Butter is one of the most easily digested and absorbed forms of fat. This may be due to the fact that the butter fat is about 40 per cent olein, a substance which enters largely into the composition of body fat; also because of its low melting-point.

Butter is the greatest source of fat in the diet of most people and is especially valuable in the treatment of such diseases as phthisis, diabetes, etc.

165. Butter Substitutes.—Butter which has stood so long that it has become rancid may be melted to get rid of the disagreeable odor and flavor and then rechurned with fresh milk or cream. The product is known as *renovated butter*.

Oleomargarine is made by churning fat together with milk or milk and cream.

166. Cheese.—Cheese is made from the curd of milk which undergoes processes of "ripening," coagulating, removing whey, salting and pressing.

Cheese may be divided into two classes:

1. *Hard*: Chedder, Edam, Swiss, Parmesan, Roquefort.
2. *Soft*: Brie, Camembert, Gorgonzola, Limburger, Neufchatel, Stilton.

Contrary to popular opinion, cheese is not difficult of digestion if eaten at the proper time and in suitable amounts. Recent experiments show that 95 per cent of the protein and more than 95 per cent of the fat is digested and absorbed. Cheese, like milk, is digested chiefly in the intestines.

Food value.—As cheese is deficient in carbohydrates, its

food value is greatly increased by serving it with carbohydrate foods such as bread, rice, etc. As it is a highly concentrated food it is well to use it in combination with such bulky foods as vegetables. As it is practically the same type of food as meat, fish, and eggs, it should be used to replace these articles in a meal, not to supplement them. If not used in too large quantities, cheese will be found useful in a diet.

SUGGESTIONS FOR LABORATORY PRACTICE

In connection with the study of the text of the preceding chapter: Make butter, cottage cheese, junket, cocoa, and cream soups.

CHAPTER XII

EGGS

167. Structure.—Structurally the egg is divided as follows:

Shell.—Composed largely of lime and magnesium salts.

White.—Composed of water, protein, ash, and small amount of fat.

Yolk.—Composed of water, protein, fat, and ash.

Membranes.—(1) The tough skin covering the whole of the egg under the shell.
(2) The delicate tissue surrounding the yolk.

168. Composition.—Eggs, like milk, contain a large percentage of water and an important amount of protein, fat and mineral salts, but no starch.

The average composition of egg as purchased is water 65.5 per cent; protein 11.9 per cent; fat 9.3 per cent; and mineral matter 0.9 per cent.

The *protein* of egg is *albumin* which is a valuable tissue building food. White of egg consists of several albumins, the chief of which is *ovalbumin.* Popularly, egg white is called pure albumin. Egg yolk also contains a number of different proteins, including a large percentage of *vitellin* and *lecithin* which furnish phosphorus in a form available for the body needs.

The *fat* of egg is found chiefly in the yolk, and, like milk fat, exists as an emulsion. Held in solution in the fat of the egg yolk is found a vitamine (*fat soluble A* is the name given to this substance by scientists), which is essential for the best growth and development of the body. A yellow coloring matter called *lutein* is dissolved in the fat

of the yolk and gives it the characteristic color. This coloring depends somewhat upon the nature of the food of the hens. Pale-colored yolks are thought to indicate a deficiency in green food.

The chief *ash constituents* of the egg are phosphorus, calcium, iron, and sulphur. The yolk of the egg is much richer than the white in these compounds, which are adapted to an important part in the building of blood, bone, and muscle. The edible portion of an egg shows an average of 0.0030 per cent of iron in forms available for use in the body. The richness of the egg in iron compounds is one of the reasons for the early addition of egg to the diet of a young child.

The high sulphur content of egg, found chiefly in the albumin of the white, results in an excess of acid forming elements and makes the egg an acid-forming food. In this particular, egg resembles meat rather than milk. The sulphur present forms hydrogen sulphide on the decomposition of the albumin, giving the bad odor to rotten eggs.

169. Food Value.—An egg of average size will yield about 75 calories. An egg weighing two and two-third ounces will yield 100 calories. One pound of egg (eight eggs of average size) will yield 672 calories or twice as much as are furnished by an equal weight of milk and a little less than the calories from a pound of lean meat. This indicates that eggs at ordinary prices are an economical substitute for meat. The exceptional nature and high food value of the nutrients of egg places it among the indispensable articles of diet in every household and gives it a prominent place in the dietary of anæmic and tubercular patients.

170. Digestibility.—Egg protein or albumin is digested and absorbed as completely as milk protein or casein (97–98 per cent absorbed), and the fat of eggs is digested as thoroughly as milk fat. Experiments have shown that eggs slightly cooked at a temperature below that of boiling water,

are more easily and quickly digested than those cooked at a higher temperature. Moderate heat makes the albumin tender and jelly-like, while strong heat makes it tough, hard, and dry, in which condition it offers more resistance to the digestive juices.

171. Selection and Care.– Eggs are divided commercially into groups according to freshness, appearance, size, cleanliness, and color.

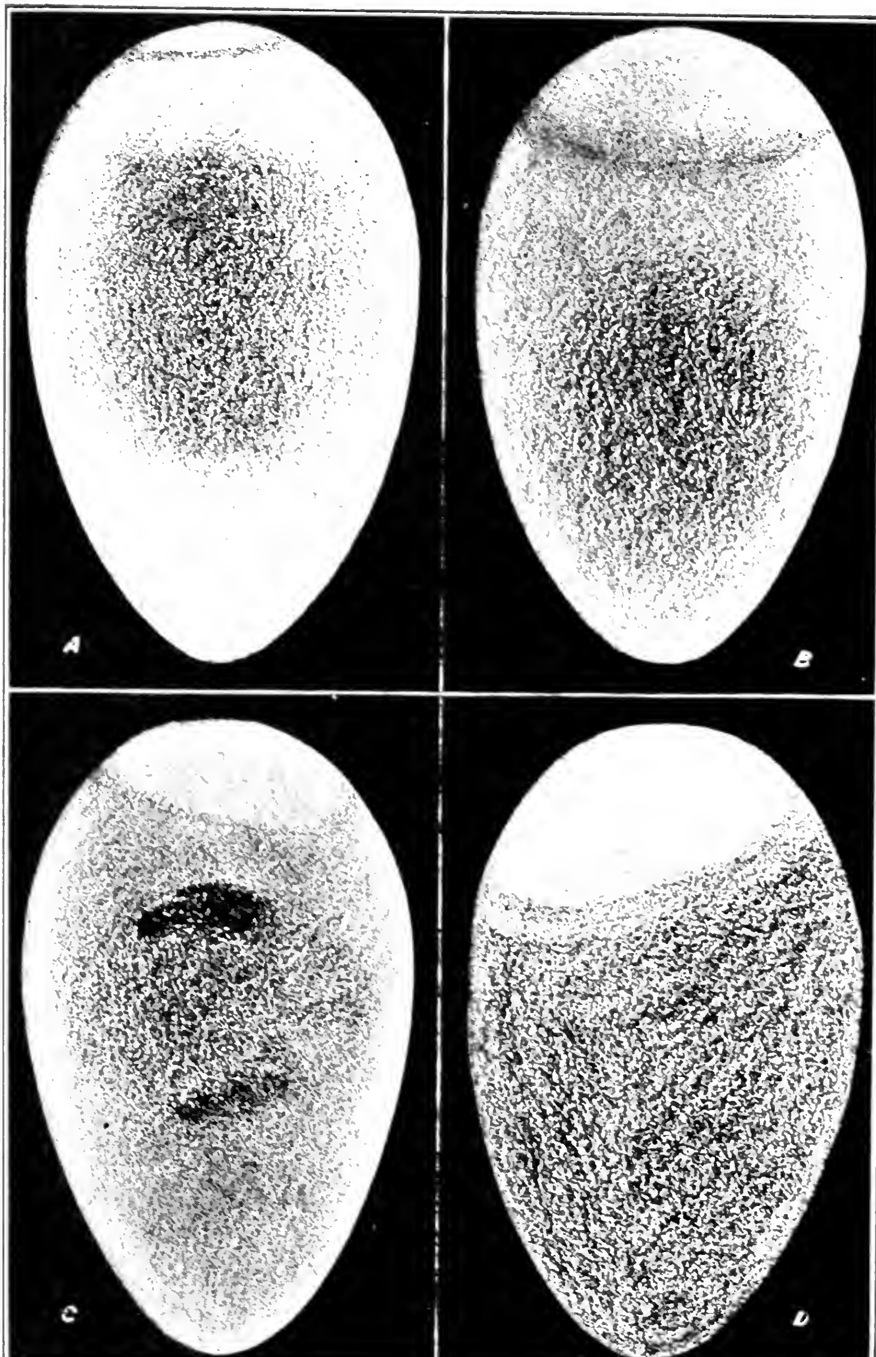
In absolutely fresh eggs, the contents very nearly fill the shell and the white is jelly-like in consistency and is practically free from bacteria. As soon as an egg is laid, the water begins to evaporate through the porous shell, gradually increasing the size of the air space inside the shell. As the evaporation continues, this space is being filled with micro-organisms which set up fermentation and cause the egg to spoil.

Freshness is determined in various ways. Candling and the salt solution tests are most frequently employed where large numbers of eggs are to be examined. Shaking to determine the fullness of the shell, and observing the roughness of the shell are the simplest of the household tests.

Candling consists in looking through the egg toward a bright light and noting the appearance of the contents. A perfectly fresh egg appears unclouded or translucent, as is shown at *A* in Fig. 27. If decomposition has begun, a dark spot may be observed which gradually increases in size as shown in *B* and *C*. A bad egg or one unfit for use appears dark colored all over as in *D*.

Crack shelled eggs are easily inoculated with bacteria or contaminated by odors and can be kept for only a short time. They are sold much cheaper and may be used when it is certain that they are fresh and clean.

Dirty shell eggs are undesirable because they have been in contact with filth and are liable to be contaminated. *Seconds* are the undersize, cracked, or soiled eggs, or those otherwise unfitted to be classed as first grade.



Courtesy of The Macmillan Co.

FIG. 27.—Appearance of different grades of eggs before the candle.

The color of the egg-shell influences somewhat the market value but not the food value. Analysis shows that there is no uniform difference in the properties and food value of brown-shelled and white-shelled eggs. Brown-shelled eggs bring the higher price in the Boston markets, while white-shelled eggs are preferred in the New York markets.

172. Specific Gravity.—At the New York State Experiment Station it was found that the average fresh egg has a specific gravity of 1.090. The changes in specific gravity correspond to the changes in water content. As the egg becomes older its density increases through the evaporation of water through the pores of the shell.

173. Preservation.—A large percentage of the eggs used are produced hundreds of miles from the consumer, thus necessitating safe methods of transporation and preservation. Eggs designed for shipping long distances should be perfectly fresh. They should be carefully packed in special cases to insure freedom from contact with materials having strong or unpleasant odors. Eggs are most plentiful and cheapest during April, May, and June, and should then be stored for use in the winter months.

The methods of preserving eggs may be grouped under three general classes:

(1) By preventing contact with the air, by immersing the eggs in a solution of some sort.

(2) By keeping them at a low temperature, as in cold storage or freezing.

(3) By evaporating the moisture as in drying.

For the individual housekeeper, preventing contact with the air is probably the most satisfactory. To accomplish this pack the eggs in a suitable container and pour over them a 10 per cent solution of water-glass (sodium silicate) until the eggs are completely covered. It is claimed that this method will keep the eggs in a wholesome condition from four to six months and retain to a surprising degree the flavor and appearance of freshness. Packing in salt,

bran, or sawdust, little end down, has been found an adequate means of preserving eggs for cooking purposes by many housekeepers. The object in all these methods is, of course, to fill the pores of the shell and prevent the evaporation of the contents.

When fresh eggs are put in cold storage, at a temperature of 32° to 34° F., they keep for several months with but slight change in quality and flavor. Eggs should be candled after removing from cold storage. It is advisable to use storage eggs soon after they are taken from storage, as they deteriorate rapidly after changing the temperature conditions. Sometimes eggs are broken and sold in the bulk. This necessitates freezing and keeping at a temperature of 30° F., or a little below freezing-point.

Broken eggs are often dried or desiccated. The product is usually ground into a powder. This powder is thoroughly mixed with water and used in place of fresh eggs.

A number of egg substitutes are on the market. They are usually a compound of corn starch and casein and do not really take the place of eggs because they do not furnish the nutrients which give the egg its prominent place as a food material.

174. Preparation and Cooking.—Eggs may be cooked in a variety of ways. In the shell, as soft cooked or hard cooked; broken and left whole, as baked or poached; beaten, as in omelet or scrambled egg; or in combination with other materials, as in puddings, custards, cakes and sauces. In all cases the effect of heat upon albumin should be kept in mind. When the white of egg is heated to a temperature of 134° F., it slowly changes to a semi-transparent mass. When heated to 160° F., it is coagulated or becomes opaque and more or less solid. The yolk of egg coagulates at a somewhat lower temperature than the white, or about 122° F.

Custards should be poached or baked in a pan of water which is not allowed to reach the boiling-point, in order to insure a smooth, jelly-like mass.

The coagulation of albumin is demonstrated in the use of egg for clearing coffee. As the coagulated albumin rises to the surface it carries with it the scattered grounds and clears the coffee.

EXPERIMENTS

Experiment 1. The Effect of Heat upon Albumin.—(1) Place the white of an egg in a beaker and heat gradually in a saucepan of water. Test with a thermometer and note: (*a*) the temperature at which it begins to harden; (*b*) the temperature at which the egg is completely hardened.

(2) Examine and compare the coagulated albumin in the beaker in (1) with an equal amount of egg white that has been boiled five minutes. Draw conclusions as to the temperature at which albumin should be cooked to make it tender and easily digested.

Experiment 2. Comparison of Lightness of Egg Beaten with a Dover Beater and with a Swedish Beater.—(*a*) Beat the white of an egg with a Dover Beater and measure the product in a standard measuring cup.

(*b*) Beat another egg with a Swedish beater.

Compare (*a*) and (*b*) as to quantity and as to the size of the air cells.

SUGGESTIONS FOR LABORATORY PRACTICE

In connection with the study of the text of the preceding chapter prepare:

Eggs: soft and hard cooked, poached, scrambled, and omelets. Boiled and baked custards.

CHAPTER XIII

MEATS

175. Structure.—Meat, which is the flesh of animals used for food, is made up of the lean or muscular tissue, fatty tissue, gristle, and bone.

If a piece of lean meat be examined under the microscope, it will be found to consist of *fiber* held together in bundles by a thin membrane which is the *connective tissue.* On closer examination these fibers are seen to be hollow tubes filled with a liquid which is called *muscle juice.*

176. Kinds.—Meat may be either tender or tough. Both kinds may come from the same animal, but from different parts of the creature.

Tender meat comes from the muscles of the animal that are used but little. There is a minimum amount of connective tissue in tender meat, and it is delicate and easily broken. The tube walls are also delicate.

Tough meat comes from the muscles of the animal that are used a great deal. The fibers are coarse and the connective tissue thick and hard.

177. Ripening.—The process known as *ripening* has much to do with the texture of meat. Immediately after slaughtering, the meat is juicy and tender, but shortly afterwards a stiffening of the muscles takes place, probably because the myosin of the muscle juice clots. The meat must then be allowed to hang or ripen, during which time an acid is formed. This acid not only acts as a solvent upon the coagulated myosin, but also imparts a pleasant flavor to the meat.

178. Composition.—Meat contains:

1. *Proteins* such as, albumin, myosin, collagen, and

elastin, and also gelatin, which closely resembles true protein.

2. *Fat* in varying amounts from 3 per cent as in dried beef, to 90 per cent in fat pork.

3. *Carbohydrates*, less than 1 per cent and in the form of glycogen or muscle sugar.

4. *Mineral matter* in the form of potash, lime, magnesia, iron, etc.

5. *Water* varying from 50 to 75 per cent.

179. Digestibility.—Meat contains the most easily and quickly digested forms of proteins, 98 per cent of which is digested and absorbed. Fat is digested according to the amount eaten, large quantities retarding digestion. The *extractives*, which are the substances which give to the different meats their characteristic flavors, also aid digestion by stimulating the flow of gastric juice.

180. Food Value.—Because of the high protein content of meat and the ease with which it is digested, meat has a high food value. Too much meat, however, may be harmful, probably owing to the fact that the decomposition products are difficult to eliminate from the body. The uric acid forming substances are abundant, and meat protein is very susceptible to intestinal putrefaction. The fuel value of meat depends to a great extent on the amount of fat eaten.

181. Selecting Meats.—All meat should come from healthy, well-fed animals, and should be free from dyes, chemicals or preservatives that in any way render it unfit for food. In choosing meat such points as color, texture, amount of fat, etc., will differ with the different kinds of meat, but general points to observe are freshness, soundness, and absence of odor.

182. Cooking.—The way in which meat should be cooked depends upon whether it is tough or tender. The object of all cooking is to kill parasites and bacteria, to improve the flavor and appearance of the meat, and to loosen the

fibers so that they may be more readily acted upon by the digestive juices. Tender meat should be so cooked as to retain the juices. This is accomplished by applying a high degree of heat at first. This sears the surface of the meat by coagulating the albumin, thus preventing the evaporation of the juices.

Tough meat should be so cooked as to soften the connective tissue and change it into gelatin. This is best accomplished by cooking in water below the boiling-point for a long time.

183. Methods of Preserving Meat.—Meat may be preserved by refrigeration, freezing, drying, canning, pickling, smoking, and the use of such preservatives as salt, sugar, vinegar, and saltpeter. Meat that is to be sold as fresh is kept in such condition, for a certain length of time, by simply hanging in the ordinary cold storage room. Certain states have laws governing the length of time the meat may be kept.

If meat is to be kept a very long time, it must be frozen—that is, none of the juices may remain liquid, and the fibers must be separated by layers of ice. This condition may be brought about by subjecting the meat to a temperature of about 15° F. Frozen meat should be thawed very slowly before cooking, otherwise it will be flabby.

184. Beef.—Beef is more extensively used than any other kind of meat. Farm cattle are supposed to give a higher grade of beef than ranch cattle. Good beef has the following characteristics:

(1) The color is bluish red.

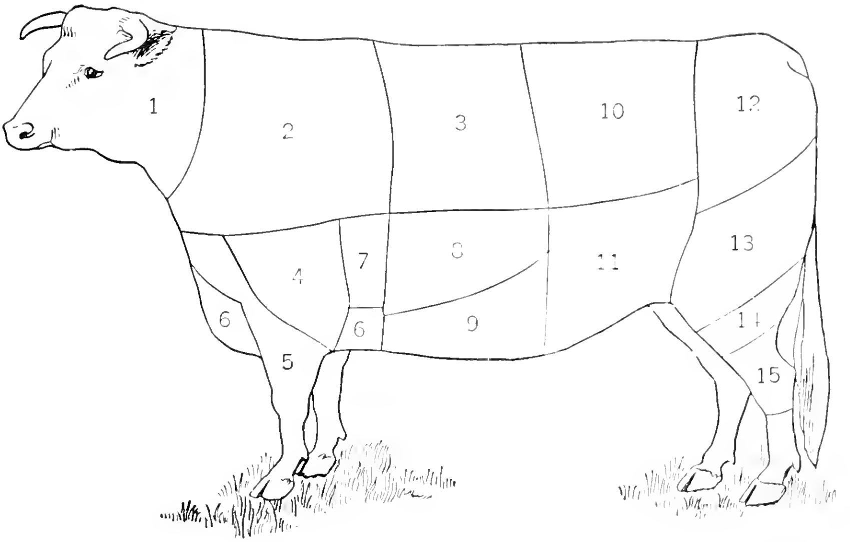
(2) The flesh is firm and elastic, scarcely moistening the finger when touched.

(3) It is almost odorless.

(4) In the more expensive cuts, the fibers are fine with very little connective tissue.

(5) The lean part is well marbled with fat.

(6) The fat is firm, clear, and free from spots.



1. Neck.
2. Chuck.
3. Ribs.
4. Shoulder clod.
5. Fore shank.
6. Brisket.
7. Cross ribs.
8. Plate.
9. Navel.
10. Loin.
11. Flank.
12. Rump.
13. Round.
14. Second cut round.
15. Hind shank.

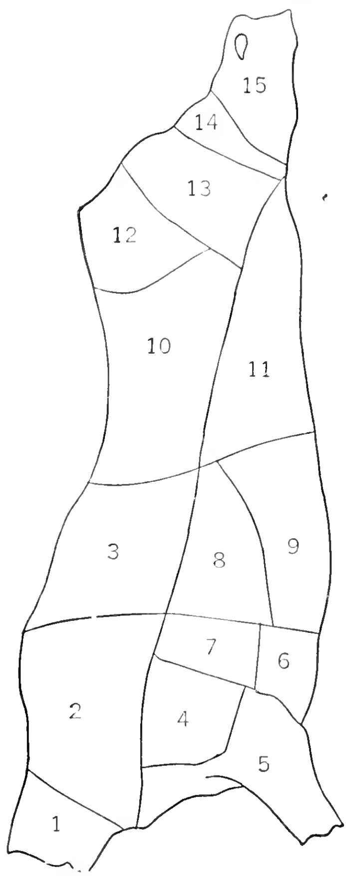


Fig. 28.—Diagrams of cuts of beef.

(7) An acid reaction is given to litmus paper. An alkaline or neutral reaction indicates that some preservative has been used.

185. Cuts of Beef.—(See Fig. 28.)

(*a*) *Fore Quarter*

Part	*Uses*
1. Neck	Beef tea
2. Chuck	Steaks and Roasts
3. Ribs, 5th and 6th	Roasts
4. Shoulder	Pot Roasts
5. Fore shank	Soup
6. Brisket	Corning
7. Cross ribs	Pot roast
8. Plate	Stewing and corning
9. Navel	Stewing and corning

(*b*) *Hind Quarter*

Part	*Uses*
10. Loin	Steaks and roasts
11. Flank	Steak and corning
12. Rump	Steak, roasts, corning
13. Round	Steaks, Beef à la Mode
14. Second cut of round	Pot roast and corning
15. Hind shank	Soups

186. Veal.—Veal is the flesh of the calf. Good veal comes from an animal about two months old. The color should be dull pink.

A recent investigation as to the comparative food value of immature veal and mature beef, has brought to light the fact that the difference in composition between the two is so slight as to be of no physiological significance. However, the larger proportion of connective tissue found in the veal makes it necessary to cook veal slowly for a long time so that this connective tissue may be softened. When this

is done the veal has been found to be quite as easily digested, and as reliable a source of nitrogen, as the beef. This discovery does away with any ground for the old prejudice against veal as an article of food.

187. Sweetbreads.—Sweetbreads are obtained from the calf. That known as the *heart-bread* is the thymus gland. It is round and much more delicate than the *throat-bread,* which is the thyroid gland, and is long and thin. The pancreas or *stomach bread* is now used very little.

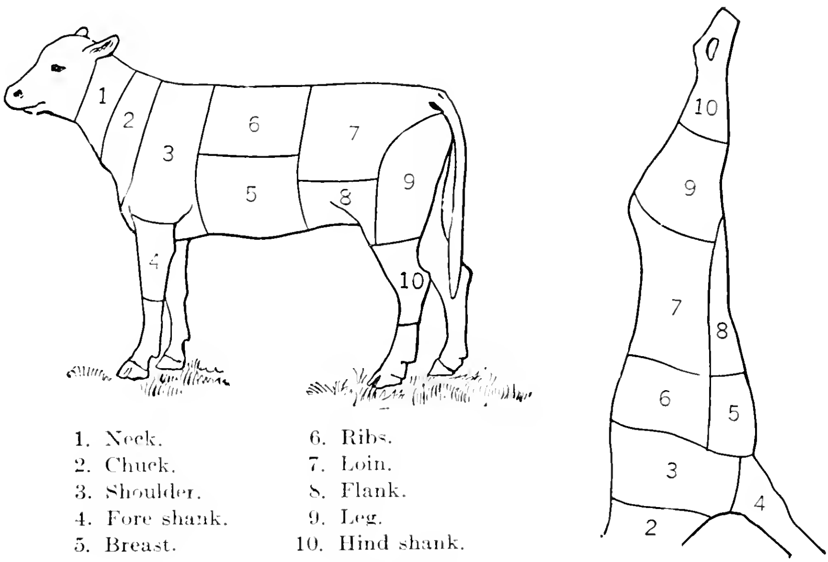


FIG. 29.—Diagrams of cuts of veal.

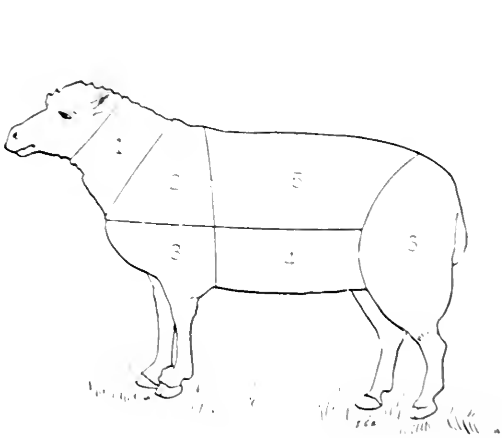
188. Lamb and Mutton.—The best mutton comes from a sheep about three years old. The flesh should be fine grained and dull red, while the fat should be white, hard, dry, rather than oily, and well distributed through the lean.

All lamb should be less than a year old. *Spring lamb* is from two to three months old. While the color of the flesh differs from that of mutton, the better way of judging between the two is by the bone. In lamb the ends of the limb bones are separated from the shaft, while in the older animal the ends become a part of the shaft and form one bone.

189. Cuts of Lamb and Mutton.—(*a*) *Hind-quarter*: Leg; loin; flank.

(*b*) *Fore-quarter*: Fore ribs; breast; neck.

Loins.—The loins are used for roasts and chops. When the bone of the rib chop is scraped free from meat, it is a *French chop*. The rib chops are considered more delicate than the loin chops and are more expensive. The loin



1. Neck.
2. Chuck or fore-rib
3. Breast.
4. Flank.
5. Loin.
6. Leg.

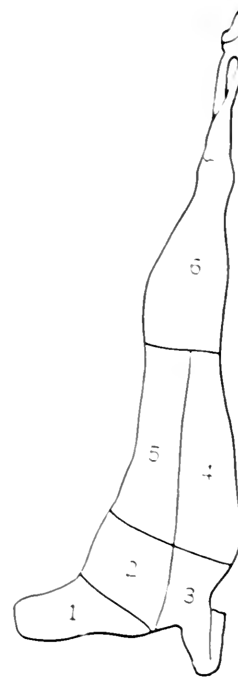


FIG. 30.—Diagrams of cuts of lamb.

chops, however, have less bone and are tender and fine in flavor. Shoulder chops, when not too high in price and from a good animal, are very satisfactory.

Breast and Flank.—In mutton the breast and flank are used for stewing, while the breast of lamb is used for both stewing and braising.

Neck.—The neck of both lamb and mutton are used for stews and broth, and, if lean and juicy, may be used for casseroles.

Saddle of Lamb or Mutton.—The saddle is formed by leaving the two loins joined together, the carcass not being split. This makes the finest of the mutton roasts.

Crown of Lamb.—This is formed by Frenching several of the rib chops, then fastening them together to form a circle. This is roasted and the center filled with vegetables before serving.

190. Pork.—Pork is the flesh of the hog, and because of

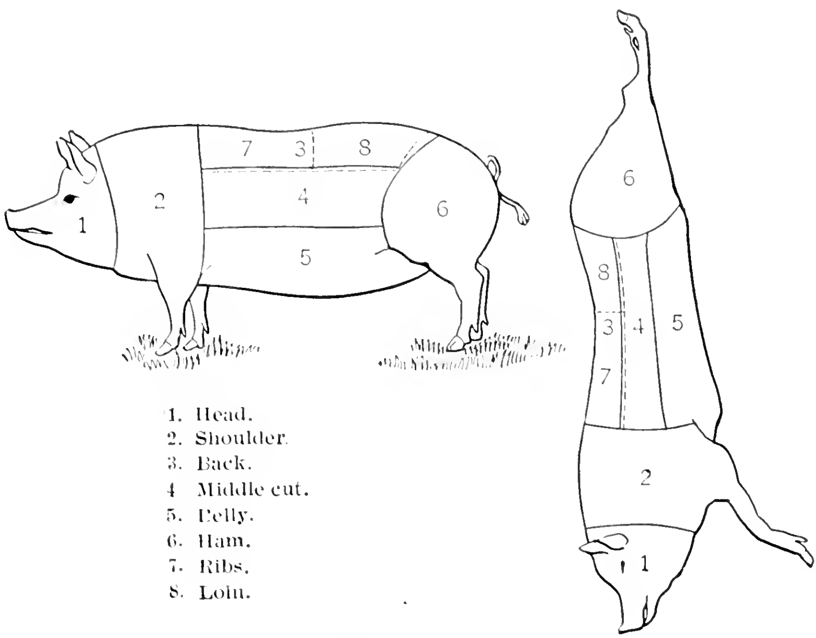


FIG. 31.—Diagrams of cuts of pork.

its indigestibility (owing to the large amount of fat present), and the possible presence of trichina or bladder worm, it is less desirable for food than the other meats. Good pork is pale red and the lean part is firm, while the fat is soft and oily. Pork should be thoroughly cooked, as this is the only way of killing any parasites that may be present.

191. Internal Organs Used as Food.—The internal organs of animals used for food are: Brains; tongue; heart; kidneys; liver; sweetbreads; tripe.

Brains are composed largely of fatty material, and, while very readily digested, are absorbed to such a small extent (43 per cent) as to make them of slight food value.

Tongue.—While beef tongue is the one that is usually indicated when the word tongue is used, calf's tongue as well as lamb's is also used. The latter is usually sold pickled. Good tongue may be recognized by its thickness and firmness. There should be a plentiful supply of fat on the under side.

Heart is very much like ordinary meat in composition, but being denser in structure it is difficult of digestion unless made tender by very long cooking.

Liver and Kidneys are very compact in structure and contain no connective tissue. They are considered difficult of digestion, and while they contain much protein, it is in a different form from that found in ordinary meat.

Sweetbreads, also mentioned under veal, page 109, are cellular in structure, the cells being held together by a loose, delicate connective tissue. On this account, they are among the most easily digested of all animal foods.

Tripe is the cleaned and boiled lining of the stomach of the beef animal. It is largely composed of connective tissue. This may be changed by boiling into gelatin and so made very digestible. Tripe has considerable fat, but owing to the absence of extractives, has but little flavor.

192. Gelatin.—Gelatin is obtained from bones, tendons, connective tissue, skin, and from calves' feet. When pure, gelatin has no odor or taste and is transparent and sparkling.

Composition. Gelatin is something like protein in composition and is very digestible. Unlike protein it is not capable of building tissue, but is sometimes used as a protein sparer because the body can make use of it in the production of heat and energy, thus sparing the more valuable forms of protein. It is much more easily broken down than the other proteins.

EXPERIMENTS

Experiment 1. Effect of Cold Water upon Meat.—(*a*) Cut raw beef into very small pieces and allow it to stand in cold water. Observe the change in the color of the water and of the meat. Explain.

(*b*) Strain off the water from (*a*) and heat it slowly in a glass beaker. Observe and account for any change in color and the presence of solid particles in the water.

Experiment 2. Effect of Boiling Water upon Meat.—(*a*) Place small piece of beef in a saucepan of rapidly boiling water. Does the water change color as in the above experiment? Why?

Account for the hard surface of the meat, and the change in color of the outside.

Experiment 3. Effect of Nitric Acid on Beef Juice.—Squeeze some of the juice from raw beef and add to it a small amount of nitric acid. Account for the result.

Experiment 4. Effect of Dry Heat upon Tough Meat.—Scrape a piece of raw beef until only the connective tissue remains. Place the tissue on a hissing hot pan and observe. Explain.

Experiment 5. Effect of Slow Cooking in Water below the Boiling Point on Tough Meat.—Cook a small piece of beef at 180° F. until the fibres can be torn apart. Explain the easy separation of the fibres.

SUGGESTIONS FOR LABORATORY PRACTICE

Cook tender meat: boil and pan broil steak and lamb chops.
Cook tough meat: make soup stock, and brown stew.
Use left-over meat in meat-pie, hash, and sandwiches.

CHAPTER XIV

POULTRY AND GAME

193. Poultry.—The domestic birds used for food are chickens, fowls, turkeys, geese, ducks, guinea fowls, and pigeons.

194. Game.—The more common wild birds and animals hunted for food are wild geese, wild ducks, quail, partridge, reed birds, squirrels, rabbits, and deer.

195. Composition.—In poultry and game, as in all other flesh foods, protein and fat are the important nutrients. The white meat or breast of chicken and turkey, has practically the same protein content but is poorer in fat than the dark meat. Also the flesh of a young bird yields more protein and less fat than the flesh of a fowl.

Poultry contains, pound for pound, a little more of the building material needed by the body and less of the energy-giving materials than the red meats, beef and mutton. However, poultry compares favorably with meat in the amount of available nutrients furnished and is interchangeable with fish and meat in the diet. Chicken is the cheapest kind of poultry and in the matter of economy is comparable with the cheaper cuts of beef and mutton. It also offers an agreeable variety to the diet and should be used in place of meat or fish as the main course of the dinner.

At the present time game animals and birds are considered a luxury, and as such are not an important part of the food supply of the country. Game is considered best after it has hung for some time or until it may be called "high."

196. Digestibility.—From the viewpoint of complete-

ness of digestion, poultry and game may be rated with the other flesh foods. If considering the relative ease of digestion, chicken is more digestible than lean meat, while duck and goose, because of the larger percentage of fat, are on a par with pork. The light meat, or breast of chicken, is composed of shorter and more tender fibres, contains less connective tissue and usually less fat than the dark meat, such as leg muscles. For these reasons light meat is preferable for children and persons having weak digestions.

197. Selection.—The breed of fowl, as well as the surroundings and food, have an influence upon the economy, wholesomeness and quality of the flesh. Birds having plump breasts and rounded legs are more economical as well as better flavored than the large boned fowls bred for laying qualities alone. The flesh of poultry allowed to roam the fields and feed upon all kinds of food is inferior in flavor and quality to the flesh of chickens fed upon grain or prepared food.

198. Picking.—The best grade of poultry is dry picked. Scalding is an easier way of removing the feathers, but by this method some of the flavor is lost, while from 8 to 10 per cent of water is added for which the consumer must pay food prices. If the bird has been dry picked, the flesh is plump, the skin is flexible, and the fat on the breast is yellow. A scalded chicken has a smooth, tight-stretched skin, often rubbed in places, and the legs are hard to bend back.

The animal heat should be removed as soon as the fowl is picked. This should be done by hanging in cool dry air for about twenty-four hours. Poultry should be shipped in refrigerator cars and kept cool and dry.

199. Chickens.—Young and tender chicken may be recognized by smooth legs, a soft thin skin, and a flexible breast bone. Rough legs, heavy blunt claws, thick rough skin, and a hard breast bone all indicate age in a fowl.

The season for broilers (chicken from two to four months

old) is from May to October. Roasting chickens are in the market from September to December, inclusive. Those bought at other seasons are probably cold storage birds.

200. Selecting Turkeys.—Turkeys under one year old have black feet, a thin skin, and a flexible breast bone. The season for fresh turkeys begins in November and ends in late February. Turkeys weighing from fourteen to twenty pounds are preferred to the larger and heavier birds. The choicest and finest turkeys in the market are dry picked, and are delivered without packing in ice.

201. Ducks and Geese.—Spring ducks and geese begin to reach the markets in May and may be had until January. Old ducks and geese may be obtained any season of the year. White Pekin ducks are valued highly for table use. They weigh from six to eight pounds when at their best. Geese at sixteen to eighteen pounds weight are considered prime.

202. Squab.—Young pigeons, called *squab,* are prime for eating when about four weeks old. Eight pounds to the dozen is the standard weight for squab. They are most plentiful in the summer months, but may be obtained all the year around.

Pigeons, which are rarely seen in the markets, are much cheaper than squab. The flesh of the pigeon requires special cooking to make it tender and palatable.

203. Guinea Fowls.—Young guinea fowls are ready for market in the early fall. Old fowls are in the market all winter. The flesh of the guinea fowl is darker in color than that of the common fowl, and the fibres are shorter. The demand for guinea fowl for table use is increasing. In flavor the flesh resembles that of game birds.

204. Preparation of Poultry.—The average housekeeper prefers to have her poultry drawn (i.e. internal organs removed) at the market. Directions for the proper procedure may be found in any reliable cook book in case they are to be prepared at home.

Boiling, stewing, roasting and broiling are the methods

of cooking commonly used with poultry. In any method the heat of cooking develops the flavors, kills micro-organisms and produces changes which render the meat more appetizing by improving the flavor and appearance. Long, slow cooking, which softens the muscle fibres and connective tissue, should be used with old and tough birds. Roasting and broiling are the methods of cooking employed for young and tender birds. In these processes the flesh is subjected to a high temperature at first in order to harden the protein near the surface. This forms a crust which prevents the further escape of the juices. After this crust has been formed, the temperature should be reduced to allow the heat to penetrate to the center without burning the outside. Frequent basting, or pouring the escaped juices over the roasting meat, helps to form a coating over the surface.

In roasting poultry the cavity is usually filled with stuffing or dressing. This stuffing is a highly seasoned mixture which serves the purpose of seasoning the bird and keeping it in shape. Some chefs prefer to roast birds without stuffing, contending that the juices of the meat are drawn out by this dressing, leaving the white meat of the breast dry and lacking in flavor.

A general rule for the roasting of chickens and turkeys is to allow twenty minutes to the pound for cooking. Ducks and geese, because of the amount of fat, require a longer time for the cooking process.

SUGGESTIONS FOR LABORATORY PRACTICE

In connection with the study of the text of the preceding chapter:

Stuff and roast fowl.

Broil chicken.

Fricassee of chicken.

Fried chicken.

CHAPTER XV

FISH

205. Quality and Flavor.—Fish, like meat, is a protein food, but unlike meat it is from one-third to two-thirds refuse and its flesh has a very large amount of water. Fish may come from fresh or salt water; those of much size usually come from lakes and the ocean, those of medium size from rivers, and very small ones are obtained from brooks.

The quality and flavor of fish depend upon various factors, chief of which are: The season, the kind of water in which they live, the substances upon which they feed, the method of capture and the way in which they are killed.

Most fish are best just before spawning, when they are said to be *in season.* During spawning, fish are likely to become flabby, with a few exceptions, such as shad and herring, which are at their best at such times.

Fish that live in deep, clear, cool water with a rocky or sandy bottom are superior to those that live in warm, shallow water having a muddy bottom. Fish which feed upon crustacea and plant substance are preferable to those which feed upon sewage products.

Fish should be killed immediately upon being removed from the water, for if allowed to die slowly, rapid decomposition results.

206. Composition.—While fish resembles meat in composition and contains the same foodstuffs, there is a difference in the amounts present. The flesh of meat has a much higher percentage of fat than that of fish. The

form of protein known as *collagen* (a substance which yields gelatin on boiling) exists in greater abundance in fish than in meat. Fish, unlike meat, is deficient in extractives and hæmoglobin, which explains the absence of flavor and color in this food. Mineral matter is present to the extent of about 5 per cent, and occurs in the form of phosphates of potash and lime with some sodium chloride. As most fish lack carbohydrates, they should be eaten in combination with some starchy food.

207. Digestibility.—Fish is supposed to be more easily digested than meat, doubtless due to the fact that the fibres are short and easily separated. Those kinds containing the smallest amount of fat are the most digestible. The accumulation of uric acid in the system is apt to be much less on a fish than on a meat diet.

208. Choosing Fish.—While the ideal way is to keep fish alive in pools of cool water until just before cooking, this unfortunately is usually impossible. Most market fish are packed in ice after having been killed, and so kept until sold. Cold storage fish are frozen solid and kept in this condition until sold. Just how much this treatment affects the taste and wholesomeness of the fish has not yet been determined, but fish so treated, if not cooked immediately after thawing, are very likely to develop ptomaines. In choosing fish see that the eyes are full and bright, the gills red, the flesh firm and stiff with no disagreeable odor.

209. Cooking.—Any method of cooking which is applicable to meat may also be applied to fish. The sooner fish is cooked after it is caught the finer the flavor. Boiling is considered the least economical method of cooking fish, as experiment has shown that when so cooked the loss in weight is between 5 and 30 per cent. If vinegar or other acid is added to the water in which fish is boiled, the protein hardens more quickly and the fish is prevented from falling apart. Fish is cooked sufficiently when the flesh becomes

dry and opaque and separates easily from the bone. Serving fish with lemon or some piquant sauce improves its flavor and makes it acceptable to many who otherwise find it tasteless and insipid.

210. Preserving.—Large quantities of fish are preserved by canning, drying, smoking, and salting. The methods of canning have now reached such a degree of perfection that much of the original flavor of the fish is retained. Canned fish is economical, as the greater part of the refuse has been removed before canning.

Dried fish usually loses about 30 per cent of its water during the process of drying. Pound for pound therefore, it is more nutritious than fresh fish.

211. Common Food Fish.—Fish are sometimes classified according to the amount of fat which they contain.

(1) Those containing more than 5 per cent of fat are: salmon, shad, herring, Spanish mackerel, and butter fish.

(2) Those containing between 2 and 5 per cent of fat are: white fish, mackerel, mullet, halibut, and porgy.

(3) Those containing less than 2 per cent of fat are: smelts, black bass, blue fish, hake, flounder, yellow perch, pike, pickerel, sea bass, cod and haddock.

212. Specially Prepared Fish.—*Sardines*, so named because they were first found off the coast of Sardinia, belong to the herring family and sometimes small herrings are substituted for them. Sardines are used fresh in Europe but only canned in oil in the United States.

Sturgeon known as white or Oregon sturgeon are found on the Pacific coast. Some are very large and until quite recently were appreciated only for their eggs or roe, from which *caviar* is made. Caviar is prepared by removing the eggs from the fish, then rubbing them to separate them and remove the membrane which envelops them. A certain amount of salt is then added, the first effect of which is to dry the eggs, but after a time the salt draws the water from the eggs and forms a brine. This brine is poured off

TABLE X.—COMMON FOOD FISH

Kind.	Description.	Wt. in Lbs.	How Sold.	Season.
	FISH CONTAINING MORE THAN 5 PER CENT OF FAT			
Salmon	Caught during the spawning season in mouths of rivers opening into the sea. Flesh pinkish.	Pacific coast 90 Atlantic coast 15–25	By the lb.	May to Sept.
Shad	Large, silvery scales, bluish brown back, flesh both light and dark. Many bones. Jack shad more flesh.	Variable	Whole.	Best Mar. and Apr.
	Roe shad finest. Roe considered a delicacy.	....	Whole.	All year.
Herring	Oily fish, unless well cured rapidly becomes rancid. 8 to 9 inches long.	....	Whole.	April to October.
Spanish mackerel	Slender, gray blue on back, white below	1 to 3	Whole.	Apr. to Oct.
	FISH CONTAINING FROM 2 TO 5 PER CENT OF FAT			
White fish	Found in fresh water. White with narrow dark stripe on back. Best from deep water.	3 to 5	Whole or by lb.	All year.
Mackerel	Dark blue back with wavy black lines, silvery below.	$\frac{3}{4}$ to 2	Whole.	Apr. to Oct.
Halibut	Large and flat, white on one side, gray on other. Both of the eyes on dark side. Flesh white, dry, and flaky. Found in northern waters.	15 to 500	By lb.	All year.
Porgy	Found in Atlantic Ocean from Maine southward. Deep notch in upper jaw. 8 to 14 in. long. Oily, fine flavor. Source of American fish oil.		Whole.	April to October
	FISH CONTAINING LESS THAN 2 PER CENT OF FAT			
Smelts	Small slender dark fish. Found on Atlantic coast. Average length 6 in.	1–2 oz.	By lb.	Sept. to March.
Black bass	Broad body with green back. Fresh-water fish.	1–1$\frac{1}{2}$	Whole.	May–June
Blue fish	Dark bluish color. Popular on Atlantic coast. Fine flavor but do not keep well. Flesh dark and nutritious.	1–8	Whole or by lb.	June to Oct.
Hake	Body long and thin. Ferocious looking. Two sets of teeth. Flesh coarse and of inferior flavor.		Whole.	Autumn & Winter.
Flounder	Flat, white on one side, white and gray on other. Fleshy. Average 8 to 10 in. in length.	$\frac{1}{3}$ to 5	Whole.	All year.
Perch	Fresh-water fish. Silvery with dark lines on back.	$\frac{3}{4}$ to 1	Whole.	May–Sept.
Pike	Large head. Abundant in fresh water.		Whole.	
Pickerel	Resembles small pike, more slender. Sometimes 2 ft. long. Maine to Florida. Common in inland lakes and ponds.	3 to 4		
Sea bass	Black lines on back. White below. Checkered between lines.	3 to 5	Whole.	Oct.–Apr.
Cod	Light green color. White stripes down the sides, mottled with gray. Flesh white, dry and flaky. Oil in liver. Found in northern waters. Cod liver oil comes from cod of Norwegian origin.	6 to 100	By lb.	All year.
Haddock	Silvery color with black line entire length on both sides. Average length 18 inches. Smoked dried and salted called Finnan Haddie.	Average 4	Whole.	All year.

and the eggs are allowed to drain from eight to twenty hours after which they are put in cans. The caviar is prized for its flavor and for its food value, which is about the same as that of the fish itself. In the roe is found *lecithin* which is a phosphorized fat.

213. Unusual Types of Fish Tested and Recommended by the Bureau of Fisheries.—*Burbot.*—This fish, though little known, belongs to the same family as the cod and is the only one of that family which is found in fresh water. The flesh is firm, white and fine in flavor, and as it comes to the market skinned, dressed, and without the head, it may be considered a very cheap food.

Bowfin.—This is very good smoked and salted.

Catfish.—While not generally appreciated catfish has been found to have a very high calorific value as food. One pound of it yields eleven hundred calories.

Sablefish.—Sablefish is sometimes called *black cod.* This fish is fine in texture and of delicious flavor. Although it comes from the deep waters of the Pacific, it can be very successfully shipped, and so can be obtained frozen as far east as New England.

Gray fish.—Gray fish is now appearing fresh in all markets along the coast but it is very good canned or smoked, and may be so obtained anywhere.

Tile fish were first discovered off the coast of Nantucket, in 1879, but while its food value was being determined and before it could be placed upon the market, it was completely exterminated, supposedly by a sudden chilling of the waters brought about by the receding of the Gulf Stream. With the return of this current some years later, the fish again appeared, and it is hoped that with an increasing knowledge of its great food value, its abundance at all seasons, and the ease with which it is captured, it may now become of great importance in the fresh fish market.

214. Shell Fish.—Under the general name of shell fish are included:

(*a*) *The mollusks.*—Oysters, clams, scallops, and mussels.

(*b*) *The crustaceans.*—Lobsters, crabs, and shrimps.

Shell fish, like other fish, are used as a source of protein in the diet. Unlike the others they contain the carbohydrate substance *glycogen* which somewhat increases their food value. They are expensive, and with few exceptions are difficult of digestion.

215. Oysters.—Oysters, which are perhaps the most used of the shell fish, are found in salt water. They vary in size according to the variety, and are not eaten until they are at least two years old. Oysters were formerly named from the locality from which they came but that custom no longer prevails. For example, *Blue Points* were originally a small variety which came from Long Island, New York. Now any small variety not measuring more than two or two and a half inches is commonly so-called. *Saddle rock* is a name given to very large oysters.

Season oysters are at their best from September to May on the Atlantic coast. They should be eaten as soon as they are removed from the shell. The practice of opening large quantities at a time and keeping them in tubs until purchased is to be deplored.

Floated oysters are those that have been treated with fresh water in order to increase their size. They usually lose flavor by this treatment, owing to the loss of some of their natural salts. There is danger also of their being contaminated.

While oysters are more easily digested when eaten without cooking the ease with which they transmit disease germs makes this a dangerous practice. Slight cooking is advisable. Long cooking toughens the oyster and renders it indigestible.

216. Clams.—There are two varieties of clams, the *long*, or soft clams, always used in the famous New England clambake, and the *round*, or hard clam, usually to be found in the markets south of New York.

Little Neck clams are a very small round variety noted

for their fine flavor. They are usually eaten raw and take the place of oysters when the latter are not in season. The composition of clams is about the same as that of other fish but many people find difficulty in digesting them.

217. Mussels.—Mussels resemble oysters, but the shell is smoother and they are found in fresh water. They are not very palatable and are not extensively used.

218. Lobsters.—Lobster is highly prized for its sweet flavor which is due to the large amount of glycogen that it contains. It is very expensive, as about 50 per cent of it is refuse, and is considered indigestible mainly on account of the coarseness and density of its fibres.

219. Crabs.—Crabs are classified as *hard shelled* and *soft shelled.* Soft shelled crabs are those which have recently shed their shell. The flesh of the crab is more delicate than the flesh of the lobster.

220. Shrimps.—Shrimps are high in food value, one-fourth their weight being made up of protein. The tail is the only portion eaten. They are usually used canned.

221. Terrapin.—Terrapin is a turtle-like reptile found in the salt water of bays and lagoons. It is valuable for the delicacy of its flesh as well as for its fine flavor and digestibility. It is scarce and very expensive. The diamond back is considered the choicest variety.

SUGGESTIONS FOR LABORATORY PRACTICE

In connection with the study of the text of the preceding chapter:

Broil mackerel; bake bluefish; boil cod; make clam chowder; scallop oysters, fry scallops.

Prepare hollandaise, tartar, and egg sauce.

CHAPTER XVI

MINERAL MATTER

222. Definition.—The term mineral matter or ash is applied to those substances found in food that are produced by the combination of the elements calcium, phosphorus, iron, sodium, potassium, magnesium, chlorine, silica, iodine, and flourine with food materials.

223. Function in Body.—These substances are essential as *body builders* and as *body regulators*. In the first instance they—especially the compounds of calcium—furnish the very important elements which enter into the formation of the bones, teeth, hair, and nails. In the absence of these elements the bones lose their rigidity and the muscles lack the ability to contract.

As body regulators mineral substances are particularly valuable to certain fluids of the body, notably the blood, which owes to the iron in the hæmoglobin its power of holding oxygen and conveying it to other tissues in the body. To the presence of calcium the blood owes its power of coagulation. The blood, as well as other tissue depends primarily upon these mineral substances, for alkalinity. In experiments to determine the effect upon the body of an ash-free diet (that is a diet of fats, carbohydrates and protein from which all mineral matter has been extracted), it was found that, in the absence of the bases or alkaline salts of the usual ash containing diet, the mineral acids resulting from the oxydation of food as well as from the body metabolism, were neutralized so slowly that the abnormal condition known as *acidosis* resulted. The solvent power and the power of osmosis (ability to pass through an animal

membrane) possessed by many fluids of the body, depends upon the presence of these mineral substances.

224. Sources of Mineral Matter.—The mineral substances required by the body are usually found in combination with other foodstuffs and, as a rule, pass into the blood unchanged by digestion. It is difficult to fix the exact amount of mineral matter required daily, but a well-known authority states that only three forms need special consideration. These are calcium, iron, and phosphorus. Other forms of mineral matter probably occur in sufficient quantities in any intelligently planned diet.

Calcium.—The body contains about 2 per cent of calcium which should be maintained by the food. The minimum amount required daily is 0.7 gram for an adult. A larger amount should be supplied in the food of a growing child to furnish material for the growth of bones and teeth. Calcium helps in the utilization of iron and has been called the "body's great harmonizer."

Iron.—The body of average weight contains approximately 3 grams of iron. This should be furnished in organic form, as it is only the iron in food that can be utilized in building body tissue. Iron in inorganic or medicinal form has been found to act only as a stimulant in aiding the body to manufacture hæmoglobin from food iron. It is, therefore, effective only when combined with foods having a high iron content. Iron is more necessary in the diet of women and children than in that of men.

Phosphorus.—The approximate amount of phosphorus required daily is 4 grams furnished in different compounds. The appearance of this element as phosphorized fat in the brain has probably led to the erroneous belief that foods rich in phosphorus are essentially brain foods.

Sodium Chloride, or common salt, is the only form of mineral matter usually added directly to the food. Often more is used than is necessary or advisable. Salt helps in the production of the hydrochloric acid of the stomach,

stimulates the appetite, and produces the thirst which encourages the drinking of more water than many would otherwise take.

TABLE XI.—FOODS RICH IN MINERAL MATTER

Weight in ounces of 100 calorie portion

Almonds	½ oz.
Beans (dried)	1 oz.
Beef (lean)	2½ oz.
Carrots	7¾ oz.
Cheese (cottage)	3¼ oz.
Chocolate	½ oz.
Egg yolk	1 oz. (2 yolks)
Lentils	1 oz.
Milk (whole)	5 oz.
Oatmeal	1 oz.
Peanuts	¾ oz.
Prunes	1¼ oz.
Raisins	1 oz.
Salmon	1¾ oz.
Spinach	14¾ oz.
Turnips	9 oz.
Whole wheat	1½ oz.
Lettuce	18½ oz.

225. Vitamines.—The name vitamines, meaning "essential to life," has been given to a group of substances about which little is definitely known. Attention was first directed to these substances when it was shown experimentally that artificial mixtures of the chemical compounds, no matter how scientifically selected and combined, failed to promote growth in young animals, but that, by adding to these compounds minute quantities of such foods as egg yolk, milk, butter and cereals, growth was at once stimulated and proceeded in a normal way. This led to the belief that there must be in natural food something besides protein, fat carbohydrate, mineral matter and water.

The form in which these vitamines exist is still a matter of doubt. Some authorities hold that, as they exist in

combination with fats, they are themselves of a lipoid or fatty nature. Others claim that the fat may serve only the purpose of holding them until called for by the body.

226. Function of Vitamines in the Body.—One form of these vitamines, which has been found to be soluble in fat, has a direct effect upon body growth. This form is present in the fat of milk, eggs, butter, cod liver oil, muscle fat, and in smaller amount in such cereal germs as those of oats, rice, corn, and wheat.

A second form, which is found to be soluble in water and alcohol, is supposed to have some marked effect upon nerve tissue and nerve activity. This form is found in eggs, meat, milk, and the outer layers, of bran, wheat, rice, corn, and oats.

While these vitamines are required only in small amounts, their absence has a disastrous effect upon the process of nutrition. Therefore, foods treated in such a way as to diminish their vitamine content should not be depended upon exclusively for nourishment. Such processes as canning, drying, boiling (in some cases, as for example milk), as well as long keeping and too great refining diminish the vitamines.

CHAPTER XVII

BEVERAGES

Besides water there are a number of beverages which are taken mainly for their pleasant flavor and stimulating effect. Tea, coffee, chocolate, and cocoa belong to this class.

227. Tea.—Tea is made from the leaves and buds of a

Fig. 32.—Tea plant. (Bailey.)

species of evergreen shrub, Fig. 32, which grows from 3 to 6 feet in height. The cultivation of the tea plant is an important industry in China, Japan, India, and Ceylon. It promises to become a considerable factor in the industries of the Southern States, where the climate is fairly well suited to the growth of tropical plants.

228. Composition of Tea.—The chemical constituents of tea are found to be principally an alkaloid, formerly called *theine*, but now known as *caffein*, and said to be

identical with the same substance found in coffee, *tannin*, certain volatile oils, and mineral matter in the form of oxalates.

Caffein is mildly stimulating to the nerves and is easily dissolved in boiling water.

Tannin, an astringent substance found also in certain fruits and vegetables, is less easily dissolved in boiling water. Upon this fact depends the principle of tea infusion.

229. Classes of Tea.—There are two general classes of tea, black and green. The two kinds may be made from the same leaves, the main difference being in the process of curing.

Black tea is prepared by allowing the leaves to stand and ferment before they are dried. This changes the color and flavor and renders the tannin less soluble. An infusion of green tea therefore contains more tannin than a like infusion of black tea.

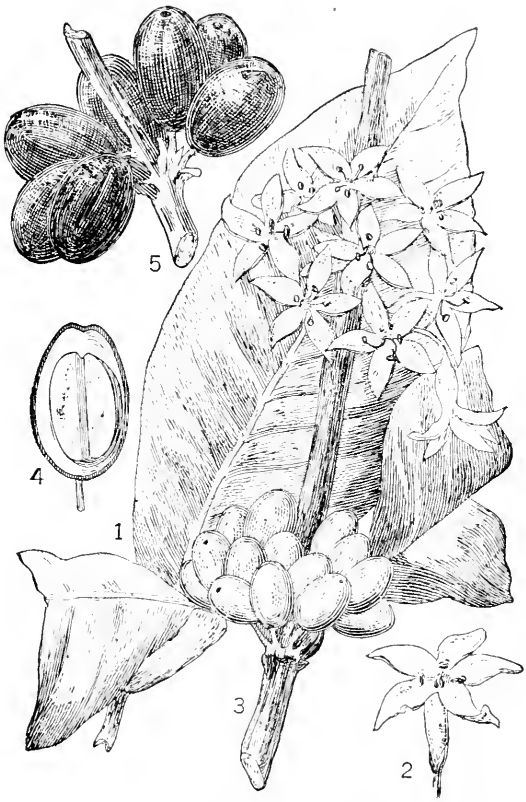
Green tea is made by drying the leaves quickly while yet fresh. A green tea infusion has a pale color and a less pungent odor.

230. Grades of Tea.—The choice brands of tea are made from the very young buds and leaves. The older and larger leaves form the less desirable and cheaper qualities. The finest quality of China tea is *flowery pecoe*, made from the leaf buds. The next larger leaves form *orange pecoe*, the still older and larger leaves *pecoe*, and the largest leaves a still lower grade called *souchong*.

FIG. 33.—Tea leaf.

231. Adulterants of Tea.—All of the tea shipped into this country is tested before it is distributed to make sure that it comes up to the prescribed standard of purity. Coloring matters are sometimes used to improve the appearance of the tea leaves. These are also frequently used on

spent leaves, or tea that has been infused, to give it the appearance of fresh leaves. Probably the usual way of adulterating tea is by the addition of foreign leaves or leaves resembling the tea leaf in size and shape. The expert can detect these upon close examination, for the



Courtesy of Bleeckers & Simon.

FIG. 34.—Coffee plant.

veining and midrib of the tea leaf are peculiar to this particular plant, see Fig. 33.

232. Coffee.—Coffee is the fruit of a shrub or tree which under cultivation grows from 7 to 16 feet in height. The fruit, Fig. 34, resembles a cherry, the beans corresponding to the pit. Two beans grow, flat sides together, in the pulp, enclosed in a tough hull. The fruit is dried and the husk removed from the berries.

The coffee growing countries rank, according to the amount produced, as follows:

(1) Brazil, which furnishes more than half of the world's supply.

(2) Mexico and Central America.

(3) Africa and Arabia.

(4) Asia.

Caffein and tannin, mentioned under tea, are equally important constituents of coffee. In addition to these and of equal importance, may be considered the volatile oil *caffeol*, which imparts to coffee its characteristic flavor and aroma.

233. Mocha and Java Coffee.—The terms Mocha and Java no longer indicate the source of the coffee, but are simply trade names signifying the quality of the blend.

234. Preparation of Coffee.—For use as a beverage, the coffee beans must first be roasted and then ground. The degree of fineness to which they should be ground depends upon the method of preparing the beverage. In finely ground coffee the cells are opened and the aromatic oils are dissolved by boiling water. It is generally maintained that the longer coffee beans are kept before roasting the better, but that after the roasting and grinding processes take place the flavor escapes in the air and the mixture deteriorates rapidly. Hence, when possible, it is desirable to roast only small quantities at a time and to grind only for immediate use. Roasting develops the caffeol and must be done with care to prevent the burning of the smaller or more immature berries. When this occurs, a bitter taste is imparted to the whole mixture.

235. Substitutes and Adulterants for Coffee.—Chief among the coffee substitutes are the cereal coffees of which *Postum* is typical. *Kaffee Hag* and *de Koffer* are both preparations of the coffee bean after the greater part of the caffein has been extracted. It is believed that these prepara-

tions may be used safely by persons unable to stand the stimulating effect of true coffee.

Chicory is the common adulterant of coffee, although dried peas, beans, and grains are added to ground coffee to increase the amount. The inferior beans are also coated or glazed with substances that will improve their appearance.

236. Chocolate and Cocoa.—Chocolate and cocoa are made from the cocoa bean, which is the seed of a native Central American tree. The fruit of the cocoa tree, Fig. 35, grows about 10 inches long and 4 inches thick and has imbedded in the pulp 20 to 40 seeds about the size of ordinary almonds. When the fruit matures, these seeds are removed and dried by the heat of the sun. The next step in the manufacture of chocolate is that of roasting and the removing of the shells. After this is done the beans are coarsely crushed to form *cocoa nibs*. The nibs are ground extremely fine, forming a thick paste which, when allowed to cool, hardens into a firm mass or cake.

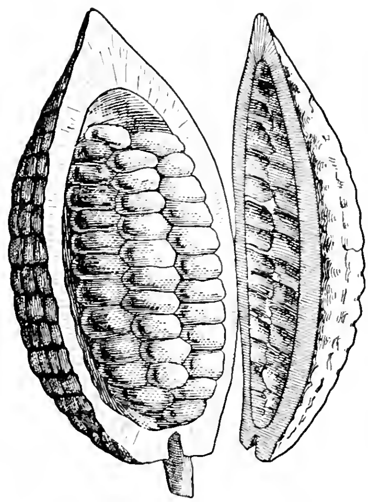


Fig. 35.—Cocoa beans.

Cocoa is the finely ground form of chocolate after most of the fat has been removed by pressure.

Chocolate and cocoa contain a stimulating principle closely related to caffein although milder in action, called *theobromin*. In addition to quite a high percentage of fat, the cocoa bean contains about 15 per cent of starch, a small amount of protein, and mineral matter. These give chocolate and cocoa a distinct food value. The fat, when extracted, is known as *cocoa butter* and is used in toilet preparations.

237. Effects of Tea, Coffee and Cocoa on the Body.— The food value of tea and coffee is due to the cream and sugar added rather than to the nutrients found in these compounds.

The exciting and stimulating effect of tea, coffee, and cocoa is due to the *caffein* or similar compounds present. A cup of hot tea, by its agreeable flavor and stimulating action upon the body, dispels the feeling of fatigue. This stimulating effect upon the heart, kidneys, and nervous system varies with different people. In some cases the reaction of the stimulant is not noticeable, in others the action of the heart is increased very perceptibly. This increased action of the heart has a direct effect upon the secretions of the cells of the kidneys.

Tannic acid in excessive amounts precipitates the pepsin of the gastric juice. This interferes with the digestion of protein foods. The small amounts of tannic acid occurring in properly made tea and coffee can do no more than to retard the digestive process. In some cases this might be desirable. For example a cup of black coffee after a hearty dinner delays the action of the juices upon protein foods and at the same time allows others to be digested in the normal manner.

The volatile oils of tea and coffee affect the body in slightly different ways. Those in the former tend to open the pores of the skin and keep the body moist, while those of the latter tend to have the opposite action. This explains why tea is given to warm the body when cold, by increasing the circulation, and to cool it when heated by increasing the surface evaporation.

Such beverages as chocolate and cocoa have a definite nutritive value in themselves, which is increased materially by the milk, cream, and sugar used in their preparation. The mild action of the stimulating principle *theobromin* makes cocoa a more desirable drink for children. Tea and coffee, because of their irritating effect upon the delicate

mucous membrane of the digestive tract and their stimulating action upon the heart and nervous system, are considered most harmful to young persons.

EXPERIMENTS

Experiment 1. Test for the Presence of Chicory in Coffee.—Add one teaspoonful of the ground suspected coffee to a glass of cold water. If chicory is present, it will make a brown streak as it sinks to the bottom of the glass.

Experiment 2. To Detect Coffee Substitutes.—(*a*) Add a tablespoonful of the ground coffee to a glass of water and note the length of time it remains on top of the water. Coffee will float for some time, as it contains a little oil. Coffee substitutes are heavier than the coffee and quickly sink to the bottom of the glass.

(*b*) Many of the substitutes contain starch, which gives the characteristic blue test with iodine. Boil one tablespoonful of coffee in one cup of water for three minutes. Filter and cool, and then add a few drops of iodine. The appearance of a blue color indicates the presence of starch.

SUGGESTIONS FOR LABORATORY PRACTICE

In connection with the study of the text of the preceding chapter, prepare:

Tea and coffee.

Fruit punches.

CHAPTER XVIII

CONDIMENTS AND OTHER FOOD ACCESSORIES

238. Value.—Condiments and other food accessories do not, as a rule, have a definite food value. That is, they do not supply building material or furnish energy to the body, although they may be considered body regulating substances in that they stimulate the flow of the digestive juices. For this reason they may be counted as essential constituents of the normal diet. Many foods, otherwise insipid, are made palatable by the addition of simple condiments to produce a pleasing flavor.

239. Salt.—Salt is probably the only condiment that is absolutely necessary for the maintenance of health. Salt is obtained in various ways, chiefly by mining rock salt or by pumping brine out of salt wells, salt lakes, or the ocean, and evaporating it in the sun. This crude product is refined for use. About nine-tenths of the large yearly output of this country comes from New York, Michigan, Kansas and Ohio.

It has been demonstrated by experiments that high grade or dairy salt is nearly pure (97 to 99 per cent) sodium chloride. For table use, salt is frequently mixed with starch or some other substance to keep it from gathering moisture from the air. In this event the product should be and usually is labeled to show this addition.

240. Vinegar.—Vinegar is one of the most useful of the unclassified foods. Its flavor is stimulating and its action in softening the fibres of tough meat and the tough cellulose of green vegetables is illustrated in the use of vinegar in preparing mint sauce for lamb, and in French dressing to be eaten with salad.

The original term "vinegar," meaning only a wine product, has come to have a broader meaning and to include the cider, malt, and sugar products.

Cider vinegar is made from the juice of apples. This ferments on standing and produces acetic acid. Cider vinegar is yellow or brownish in color and has the odor of apples. It also contains the malic acid of the apple juice.

Wine vinegar is a similar product made from the juice of grapes. For table use white wine vinegar, from the white grape, is considered superior to the red, which is made from the juice of the purple grape. Tartaric acid, the characteristic acid product of the grape, is found in wine vinegars.

Sugar vinegar is the result of the fermentation of sugar, syrup, or molasses solutions.

241. Spices.—Most spices owe their characteristic taste and odor to the presence of some one of the volatile oils. Since their chief effect is to stimulate the appetite, their use is not advised in the diet of children.

Ground spice is more often adulterated than whole spice. The detection of finely ground foreign matter, such as flour or other starchy or fibrous materials, is rather difficult in the ground products. Whole spices are frequently adulterated by removing a part of the important constituents of the berries.

Allspice is the dried fruit of an evergreen tree grown in the West Indies. The berries are gathered when full grown but while they are still green. Allspice receives its name from its resemblance in taste to a mixture of ground cinnamon, cloves, and nutmeg.

Anise is the seed of a plant of the parsley family native to Africa but now cultivated elsewhere. It is used in breads and other foods.

Bay Leaf is the dried aromatic leaf of a species of laurel.

Capers are the dried flower buds of the caper plant. This bush, a native of Southern Europe, grows from 3 to 5 feet

in height. The flower buds are gathered when about the size of a pea and are preserved by pickling in vinegar.

Celery seeds obtained from the common plant are used as a seasoning substance either ground or in the form of an extract.

Cinnamon is the inner bark of a small tree grown in Ceylon. It has an agreeable odor and flavor and is used as a medicine as well as a flavoring matter.

Cloves are the dried flower buds of the clove tree, an evergreen grown in the West Indies and other places.

Ginger is the starchy root of a plant of Southern Asia. Ginger is, therefore, a food as well as a condiment. The rhizome, or underground stem, is dried and sold as root ginger, or ground finely, for powdered ginger. The young roots are sometimes cooked and preserved in syrup for the preserved ginger of the market, or crystallized by boiling in sugar.

Nutmeg is the dried seed of the fruit of the nutmeg tree. The unground nut is commonly used, the spice grated into the food as desired. It is preferred in this way since it loses flavor readily when ground.

Mace is obtained from the surrounding membrane of the nutmeg.

Pepper is the berry of a climbing plant found in tropical climates. Black pepper is the ground berry before it ripens. White pepper the ground berry after it ripens.

Cayenne pepper is made from the pod of a species of Capsicum. It is a strong irritant to the skin and mucous membrane.

Paprika is the ground ripe fruit of the capsicum, the seeds and stems having been carefully removed before grinding.

Mustard is obtained from the seeds of the black or white mustard plant. Mustard grows wild in some localities and is also extensively cultivated. The white mustard seeds are sometimes used whole in pickles and relishes.

Prepared mustard is made by grinding the seeds and mixing with other spices and oils or vinegar. Ground mustard, when applied to the skin, acts as a counter irritant and is often useful in relieving acute pain.

Sage is a common garden plant, the dried leaves of which are used extensively in the preparation of sausage, and as a seasoning for other meats, poultry, and dressings of various kinds.

Thyme is a perennial plant growing in the form of a small shrub 6 to 10 inches high. The leaves and young shoots are used for seasoning purposes.

242. Flavoring Extracts.—Of the relatively large number of flavoring extracts made, the extracts of vanilla, lemon, and almond are the ones universally used.

Vanilla extract is made from the vanilla bean, which is the fruit of a climbing vine belonging to the orchid family. Those grown in Mexico are considered of a superior quality. The beans are allowed to ferment before drying to develop the characteristic properties. The extract which is sold for flavoring purposes is made by soaking the beans in alcohol. This fact accounts for the loss of flavor by evaporation, especially in hot foods.

Lemon extract is obtained by soaking lemon peel in alcohol, which extracts the volatile oil needed as a flavoring substance.

Almond extract is a flavoring substance prepared by soaking the seed of the bitter almond in alcohol.

CHAPTER XIX

FOOD REQUIREMENTS OF THE BODY

243. Necessity for Food.—The body requires food in definite quantities for three well-defined purposes: (1) To furnish energy; (2) to provide material for growth and repair; (3) to satisfy its need for those substances which stimulate growth and regulate body processes.

244. Amount Required.—Several factors determine the amount of food required daily for a given individual, but the chief ones are age, weight, and activity of the body.

To estimate the amount of food necessary to fulfill the first requirement, that of supplying energy, should be no more difficult than to estimate the amount of gasoline which an engine will use in running a certain number of miles. As the fuel value of food is reckoned in terms of a unit known as the calorie, it is most essential to know exactly what is meant by the term. As the number of calories required will vary with the body weight and the degree of activity, it will be necessary to know how many calories per pound of body weight, per day, will be used under these varying conditions. And finally, as the calories are yielded by the oxidizable foodstuffs such as protein, fat, and carbohydrates, it will be necessary to know the proportion of these present in the food materials, and to know how many calories a given amount of each will yield.

By a **calorie** *is meant that amount of heat which will raise the temperature of one pound of water four degrees Fahrenheit.*

The number of calories required by an adult has been found by scientific experiments to approximate the following:

At rest..................	13 to 14 calories per lb., per day.
At light exercise..........	16 to 18 calories per lb., per day.
At moderate exercise......	18 to 20 calories per lb., per day.
At severe exercise........	20 to 23 calories per lb., per day.

Using the above data, it will be seen that a person weighing 150 lbs. and taking no exercise will require 150×14 or 2100 calories per day. The same person exercising severely will require as high as 150×23 or 3450 calories per day.

245. Computation of Energy Value of Foods.—The necessary information regarding the proportion, in terms of grams, of the foodstuffs in various food materials, may readily be obtained from any of the Government Bulletins. As each of these foodstuffs yields a certain number of calories, the protein and carbohydrates yielding 4 calories per gram, and the fat yielding 9 calories per gram, the total calories, furnished by a given amount of food may readily be computed.

Example.—*To determine the total energy in calories furnished by* one pound of white bread. One pound of white bread contains 41.27 grams of protein, 7.26 grams of fat, and 241.75 grams of carbohydrates. The energy furnished is therefore:

By the protein,	$41.27 \times 4 =$	165.08 calories
By the fat,	$7.26 \times 9 =$	64.35 calories
By the carbohydrate,	$241.75 \times 4 =$	967.00 calories
Total energy		1197.42 calories

246. Requirement for Growth and Repair.—The second requirement is often spoken of as the *protein requirement* of the body, as it is upon protein that the body chiefly depends for growth and repair may also be estimated in terms of calories. One way of making certain that this protein requirement is met is to see that from one-eighth to one-tenth the total calories of the day's rations are derived from protein foods. Another way is to allow from 2 to 3

protein calories for each pound of body weight for an adult, and from 4 to 6 protein calories per pound of body weight for a growing child.

247. Requirement for Body Regulation.—To satisfy the body's third requirement, that is, its need of *growth stimulating and process-regulating* substances, is, at the present time, by no means a definite, well understood task. All that can be done along this line, in the light of present investigations, is to make an intelligent use of *all* foods. In this way a sufficient quantity of these substances to meet the needs of the body is reasonably well assured.

SUGGESTIONS FOR LABORATORY PRACTICE

In connection with the text of the previous chapter each pupil should calculate her own food requirement per day.

Weigh and compare the 100 calorie portion of several of the common food materials.

CHAPTER XX

FOOD COMBINATIONS IN MEALS

THE food requirements of the body have been defined in the previous chapter. In the present chapter the question of the combinations of foods that will meet these requirements will be discussed.

248. Planning Meals.—Planning satisfying meals involves, first of all, a definite idea of the family income and of what part of this can properly be appropriated for feeding the family.

The wise expenditure of money thus set aside falls upon the housekeeper. The degree of success she will achieve in her efforts will depend upon her knowledge of the body needs of each individual under her care and of the kinds of foods that will best supply these needs. She must know the seasons at which various food supplies are most plentiful, and therefore best and cheapest, and how to select, prepare, and serve them in an attractive manner. *By satisfying meals* is meant meals that satisfy hunger and please the taste, as well as meet the body requirements.

249. Per Cent of Income to be Set Aside.—Catering for a group of normal adults with all necessity for considering the cost of food eliminated would be a comparatively simple task. But the present pressure upon the economic side, due to the high cost of the staple foods, is forcing the housekeeper to exercise the greatest care and judgment in the expenditure of the food allowance. Just what percentage of the income this allowance should be, depends upon many things, but chiefly upon the amount of the income. The smaller the yearly income, the higher the percentage that

Photo by Paul Thompson

Fig. 36.

must be allowed for food. It has been estimated that, in normal times, 25 per cent of an income of between \$1500 and \$2000 will furnish adequate nourishment for the average family.

250. The Food of Adults and of Children.—From the standpoint of nutrition, the planning of meals resolves itself into something more complicated than the mere satisfying of hunger. The housekeeper must take into consideration the age and growth needs of the children and the occupation and amount of exercise taken by each member of the family, in order to be able adequately to judge the kind and amount of food required by each. The man at active muscular work will use up more calories than the man of sedentary habits, and will be able to digest with ease the heartier foods. Children require special attention with regard to the supply of growth stimulating foods. It is an established fact that a man can dispense with such foods as eggs, milk, cream, and butter better than the women and children of the family.

251. The Cost of Foods.—Important considerations in planning meals are the cost not only of the raw food materials but of the fuel consumed, and the time and labor required in their preparation.

The problem of the cost of living is becoming more and more serious every year. Whatever the reason for the increase in the price of food, it is quite certain that former low prices will not be restored. Fuel is more expensive. Wages of domestic help are higher. Apparently the only way by which to combat these conditions is through more careful and intelligent buying. By studying market conditions cheaper foods, equally wholesome and identical in nutritive value, may be substituted for high priced foods.

Judicious buying implies a knowledge of the different cuts of meat and their possibilities, and the ability to distinguish between waste (bone and gristle) and solid meat. Judgment in buying staple goods in quantities whenever

possible, and in buying perishable goods in season, as well as an understanding of their value and place in the diet, is gained by study and experience. This knowledge and experience may be possessed by every housewife who is willing to expend the necessary time and effort.

False economy in food results in a poorly nourished family, the members of which are readily susceptible to disease because their resisting powers are not kept high by proper nourishment. It should be remembered that money saved on food is often spent on doctor's bills.

252. Balanced Meals.—To so plan each meal as to supply a definitely prescribed amount of each foodstuff is an impossible task. The one time much over-worked term, "balanced meals," has therefore lost its implied meaning of furnishing the correct proportion of the foodstuffs for each meal. In its newer and broader sense, the term signifies providing a well-selected variety of foods which will furnish a well-rounded diet. In the course of the day such a diet will offer a sufficient amount of all kinds of foodstuffs and will thus meet all the various requirements of the body.

253. Variety in Diet.—The old saying, "variety is the spice of life," holds good in the planning of meals. Effort should be made by the housekeeper to furnish variety and novelty in the preparation and serving of the more common foods in order to tempt the appetite and relieve the monotony of the ordinary diet.

Great variety is not desirable at one meal, but the serving of any food prepared in the same way day after day is the surest way of making it a drug on the appetite. With over two hundred ways of cooking eggs, for instance, it is possible to surprise the family with a new dish occasionally.

254. Aesthetic Considerations.—The appearance of a dish when served is more of a factor in its proper digestion than is always realized. A dish that is pleasing to the eye whets the appetite quite as much as one that is pleasing in flavor and lacking in attractiveness.

Salads as a group of foods, offering as they do essential foods alone or in combination, furnish endless opportunity for the taste and originality of the housekeeper in producing pleasing effects. The plainest and most ordinary foods, by a tasteful use of some simple garnish, are made to appear unusual and interesting. Garnishes should, however, be of suitable materials, that is, should be some kind of edible greens or other food substance. Desserts are improved in appearance and hence in digestibility by dainty ways of serving.

255. Protein Foods.—The protein foods are sometimes classified as A, B, C, and D proteins, according to their value in the nutrition of the body. To the A proteins belong the animal foods, lean meats of all kinds, fish, eggs, and milk, because they contain all the protein units which, when taken together, form the body proteins.

Fish are plentiful and cheap in many localities and especially so in sea coast towns where they may be had fresh from the water. Fish offers a satisfying substitute for the red meats at least twice a week, and is substantial enough to take the place of the roast in the ordinary menu.

Eggs should be used as freely as the income will allow, because of the combination of protein and the valuable vitamine substances (see Chapter XVI, par. 226).

Milk should be provided for all members of the family but more especially for the young children. An allowance of one quart of milk a day each is urged for those members of the family group who have not yet reached full growth. This amount may be taken on cereals, in puddings, etc., if desired, instead of as a beverage.

It has been said that as much money should be spent for milk as for meat in every household. Even at the present price per quart, fifty cents will purchase more nutriment in the form of milk than in the form of beef. *Cheese*, a product of milk, is a highly concentrated form of food and one which offers a good substitute for meat.

The B and C proteins are those foods which are rich in protein but which contain more of other foodstuffs. In these classes not yet clearly defined we have the cereals, nuts, macaroni, and some vegetables. The protein content of such foods is inferior to that of animal foods because the units are in different relation to one another than the protein units found in the body. In vegetables certain of these important units are lacking entirely. However, these foods may be combined with left-over meats or used alone occasionally to furnish a sufficient quantity of tissue building material for the day.

To the D proteins belongs gelatin, which is of food value only as a "protein sparer," (see par. 192) since it in no way builds or repairs body tissue.

256. Carbohydrate Foods.—Of the foods classified as carbohydrates, starches and sugars are the most important. The chief sources of starch are the cereals, potatoes, and bananas. Since it is necessary for normal metabolism that the greater number of calories of body heat be produced by carbohydrate foods, it is essential that some kind of cereal food form a part of the daily food allowance. The cereal savers—potatoes, sweet and white, and bananas—when eaten freely, take the place of a part of the grain products demanded.

Sugar, which is only a fuel food, should be taken in combination with some building food, such as milk, eggs, etc., or with foods containing mineral matter, as fruits or green vegetables. Nearly all fruits contain sugar and may be used as sugar sparers, since less sugar is required when fruits are used in abundance.

257. Fats.—The foods classed as fatty foods are butter and butter substitutes, cream, olive oil, bacon, and fat from meat and nuts. Butter and cream are probably the most important sources of easily digested fat.

258. Mineral Matter.—The average diet provides for the ordinary mineral substances of the body in sufficient

amounts. But the importance of iron, calcium and phosphorus in normal nutrition is great enough to warrant special attention in selecting foods containing these in larger quantities.

Milk is the chief source of calcium or *lime*, and where it is used plentifully, a proper supply of calcium is provided. *Iron* and *phosphorus compounds* are not always adequately supplied by a freely chosen diet. A list from which to select foods rich in the above minerals has been supplied in the previous chapter and attention should be given to selecting an abundance of these foods in planning meals.

259. Water.—Water is needed to supply the needs of the tissues and to provide the fluids of the body. The old predjudice against drinking water at meals has been superseded by the belief that one or two glasses of water at meals, if not taken to wash down the food, are beneficial. The liquid is regarded as a help in the digestion of the solid foods.

260. Desirable Food Combinations.—A well planned menu leaves no room for criticism in regard to color, flavor, and attractiveness, besides representing the essential foodstuffs. In combining foods, the flavor, consistency, and similarity need special consideration. Insipid foods require piquant sauces. Two creamed dishes should not be served at the same meal, nor two kinds of sauce or gravy at the same time. The same kind of food should never be served twice in the same meal; for example tomato soup and stewed tomatoes as a vegetable, or fruit as an appetizer and as a salad or a dessert. Rich desserts are not needed after a hearty dinner. Fruit ices are better than rich creams. A simple green salad with French dressing is better for dinner than the heartier cheese, egg, or fish salad with mayonnaise. A hearty chowder or vegetable soup calls for a less heavy meat. Cream of vegetable soups are more suitable for luncheon and may furnish the hearty part of the meal, while the clear soups, consommé and bouillon, are better

appetizers at the beginning of a hearty dinner. At least one succulent vegetable should be served with the dinner.

Certain long-established food habits determine common food combinations: for example, apple sauce is served with pork or goose, boiled mutton is improved by caper sauce, roast lamb by mint sauce or currant jelly, and cheese is relished with pie. Back of each of these natural food choices is a principle which is recognized as the body's effort to regulate its own needs. The acid of apple sauce in the first instance helps to digest the fat in pork and goose. The sauces bring out the flavor of the meat in the second case, and the cheese furnishes the protein which the pie lacks. These examples illustrate the normal cravings of the body for foods easy of digestion, pleasant of flavor, and balanced in foodstuffs.

261. Suggestions for the Meals of the Day.—(1) **Breakfast,** which is the simplest and most informal meal of the day, may consist of a choice of the following foods:

Fruits, fresh or stewed. The mildly acid fruits are most desirable.

A cereal served with cream or milk. The whole grain cereals are preferred because they furnish all of the nutrients of the grain.

Meat, consisting of chops or steak or meat substitutes, eggs served in many ways, small fish, bacon, salt fish.

Bread, hot or quick breads such as muffins, popovers, Johnny cake, griddle cakes, waffles, rolls, or toast.

A beverage, as coffee, tea, cocoa, and milk.

(2) **Dinner,** which is the heartiest meal of the day, is served at night or at the noon hour. The simple dinner has a soup, a meat, a salad and a dessert course. An elaboration of these foundation courses constitutes the formal dinner menu.

Soup—clear—consummé or bouillon.

Meat—served in the form of a roast, meat pie, steak, stew, fish, and poultry.

Vegetables—potatoes, and one other vegetable.

Salad—some kind of green salad vegetable with French dressing.

Dessert—ices, creams, simple puddings, fruits, with tea or coffee and milk.

Soup and salad are not necessary at the same meal and one or the other may be eliminated if desired. The chief value of the clear soup at dinner is to stimulate the flow of the gastric juice and prepare the stomach for the hearty meal to follow. The salad course offers an opportunity to introduce a succulent vegetable into the menu, the value of which lies in its mineral and water content and the addition of an easily digested form of fat in the salad dressing.

(3) **Luncheon or Supper,** as the case may be, has the same number of courses as the dinner, but is made up of much less hearty foods. An informal luncheon may consist of one or two courses only and still offer the needed variety.

Soup—cream of vegetable, clam chowder, or vegetable soup.

Meat—a hot meat dish such as hash, stew, chops, made dishes, meat substitute dishes, scalloped dishes, fish, eggs.

Bread in some form.

Vegetables—poatoes such as creamed, scalloped, lyonnaise, etc., or other vegetables prepared in a simple way.

Salad.—The salad may be hearty enough for the main course of the luncheon, as chicken, fish, egg, cheese, or fruit with mayonnaise dressing.

Dessert—fruits, ices, creams, pastry, cakes, cookies.

SUGGESTIONS FOR LABORATORY PRACTICE

In connection with the study of the text of the preceding chapter:

Plan three meals a day for the different seasons.

Estimate the daily food requirement and plan suitable meals to meet this requirement.

SAMPLE MEALS

For Winter:

Breakfast

Stewed Prunes
Oatmeal — Cream or Milk
Muffins — Omelet
Coffee

Breakfast.	Amount.	Calories.	
Stewed prunes	4 or 5 medium	100	
Rolled oats	2 tbsp. (cooked)	100	
Thin cream	1/3 cupful	150	
Egg muffins	2	131	
Butter	1 square (1 tbsp)	100	
Omelet	1 egg	116	
Coffee:			
Cream	1 tbsp. thick	50	
Sugar	2 lumps	50	
			797

Luncheon

Mixed Vegetable Soup
Spaghetti and Rice — Cheese Sauce
Gingerbread — Whipped cream
Tea

Luncheon.	Amount.	Calories.	
Vegetable soup	1 cupful	75	
Wafers	3 saltines	50	
Spaghetti and rice with cheese sauce	3/4 cupful	235	
Gingerbread	Piece 2×2 in.	115	
Whipped cream	2 tbsp. (unwhipped)	100	
Bread	2 thin slices	100	
Butter	1 square (1 tbsp.)	100	
			775

Dinner

Barley Soup
Roast Pork — Mashed Potato
Roasted Onions — Apple Sauce
Roumaine Salad — French Dressing
Tapioca Sponge
Coffee

Dinner.	Amount.	Calories.	
Barley soup	1 cupful	65	
Roast pork	1 serving (about 4 oz.)	320	
Mashed potato (seasoned)	1 cupful	204	
Roasted onion	1 large	65	
Apple sauce	3/8 cupful	96	
Roumaine salad and French dressing	1 small serving	100	
Tapioca sponge	3/4 cupful	241	
Bread	2 thin slices	100	
Butter	1 square	100	
			1291
Total for day			2843

For Summer:

BREAKFAST

Moulded Farina with Fruit Cream or Milk
Toast Coffee

Breakfast.	Amount.	Calories.	
Farina with banana	½ cupful farina, 1 banana	175	
Whole milk	½ cupful	63	
Toast	2 slices	200	
Butter	1 square	100	
Coffee:			
Cream	1 tbsp		
Sugar	2 lumps	100	
			638

LUNCHEON

Cream of Spinach Soup
Fruit and Nut Salad Boiled Dressing
Graham Tea Biscuit
Tea

Luncheon.	Amount.	Calories.	
Cream of spinach soup	1 cupful	178	
Wafers	3 Saltines	50	
Fruit and nut salad with boiled dressing	1 cupful	234	
Graham tea biscuit	2 medium	116	
Butter	1 square	100	
			678

DINNER

Planked White Fish
New Potatoes Butter and parsley
String Beans
Cream Cheese and Prune Salad French Dressing
Lemon Ice Cookies
Coffee

DINNER.	Amount.	Calories.	
Planked fish	1 serving	180	
Potatoes with butter sauce	3 small, 1 tbsp. butter	200	
String beans	1 serving (⅛ of qt.)	54	
Salad:			
Prunes	3 medium	75	
Cheese	3 balls	100	
French dressing	1 serving	90	
Wafers	3 saltines	50	
Lemon ice	1 serving	120	
Cookies	2 medium	96	
Bread	2 thin slices	100	
Butter	1 square	100	
			1165
Total for the day			2481

For a Meatless Day:

BREAKFAST

Orange

Steamed Barley — Cream or Milk

Poached Egg — Toast

Coffee

Breakfast.	Amount.	Calories.	
Orange	1 large	100	
Steamed barley	½ cupful	60	
Thin cream	⅓ cupful	150	
Poached egg	1	67	
Toast	2 slices	200	
Butter	1 square	100	
Coffee:			
Cream	1 tbsp. (thick)	50	
Sugar	2 lumps	50	
			777

LUNCHEON

Baked Beans — Brown Bread

Lettuce and Grapefruit Salad — French Dressing

Sponge Cake

Tea

Luncheon.	Amount.	Calories.	
Baked beans	⅔ cupful	200	
Brown bread	2 slices	150	
Salad:			
Grapefruit	½ of medium		
French dressing	1 serving	140	
Sponge cake	Piece 2×2 in.	169	
			659

DINNER

Little Neck Clams

Nut and Cheese Loaf — Tomato Sauce

Stuffed Baked Potatoes — Lima Beans

Hearts of Lettuce — Russian Dressing

Deep Apple Pie

Coffee

Dinner.	Amount.	Calories.	
Little Neck clams	½ doz.	40	
Nut and cheese loaf	1 serving	389	
Tomato sauce	1 serving	93	
Stuffed baked potato	1 medium	116	
Lima beans	½ cupful	100	
Lettuce and dressing	1 serving	224	
Bread	2 thin slices	100	
Butter	1 square	100	
Deep apple pie	1 serving	224	
			1386
Total for day			2822

For a Wheatless Day:

BREAKFAST

Baked Apple
Fried Corn Mush Maple Syrup
Coffee

Breakfast.	Amount.	Calories.	
Baked apple	1 large	200	
Fried corn mush	1 serving	100	
Maple syrup	2½ tablespoonfuls	150	
Coffee:			
Cream	1 tablespoonfuls	50	
Sugar	2 lumps	50	
			550

LUNCHEON

Cream of Potato Soup
Lentil and Rice Cakes
Rye Rolls
Sliced Pineapple Oatmeal Cookies

Luncheon.	Amount.	Calories.	
Cream of potato soup	1 cupful	213	
Lentil and rice cakes	2 (small)	205	
Rye rolls	2 (medium)	100	
Butter	1 square (1 tbsp.)	100	
Pineapple	1 slice	100	
Oatmeal cookies	3 (small)	75	
			793

DINNER

Roast Beef Sweet Potato Pone
Baked Stuffed Tomatoes
Asparagus and Pimento Salad Mayonnaise Dressing
Cornmeal Crisps Butter
Fruit Whip

Dinner.	Amount.	Calories.	
Roast beef	2 thin slices (size of hand)	200	
Sweet potato pone	1 medium	250	
Baked stuffed tomato	1 medium	35	
Salad	1 portion	60	
Mayonnaise dressing	1 portion	224	
Corn meal crisps	5 small	50	
Butter	1 square	100	
Fruit whip	1 portion	241	
			1160
Total for day			2503

CHAPTER XXI

THE PRESERVATION OF FOODS

262. Why Food Spoils.—The spoiling of food is due to two agencies. First, the action of bacteria, yeast, and mold plants causes undesirable and sometimes harmful changes to take place in food materials; second, there are present in eggs, meat, and the seeds of plants substances having the power to carry on certain changes in the foods. These changes, or life processes, are the natural ripening and maturing of fruits, the growing of seeds, and the final decay of all substances.

The organisms which cause the fermentation and putrefaction of food materials are microscopic, that is, they cannot be seen without the aid of a microscope. Although we are unable to see the bacteria and other micro-organisms, they are present everywhere in the air, in the soil, and in water. We have proof of their activity in the odor of decayed food, the gas from fruit that is fermenting, and the mold on bread and other foods. These micro-organisms exist in two forms: the *spore stage* and the *active stage.* When conditions are not right for their growth, they enter the spore stage for rest. In this form they are able to resist for hours a degree of heat equal to the boiling-point of water.

All micro-organisms require warmth, moisture, food, and oxygen for normal growth and development. Conditions favorable for the growth of bacteria and other plant life are also favorable for the ripening, maturing, and decaying processes. Therefore, if the food is to be kept for a period of time it is necessary to protect it from the former, and to prevent the natural changes due to the latter by some form of preservation.

263. Ways of Preserving Foods.—Foods are preserved, according to their kind and condition, by any one of the following methods:

(1) By the use of low temperature.
(2) By the use of high temperature.
(3) By the use of preservatives.
(4) By the removal of moisture.

264. Low Temperature.—By keeping them in cold storage or by freezing, many foods may be maintained for months in a fairly good condition. The low temperatures interfere with the growth of the bacteria which causes putrefaction and decay. Eggs, meat, butter, fish, and poultry are the foods most commonly kept by this means.

265. High Temperature Canning.—Success in canning depends upon the absolute sterilization (heating to the boiling-point and keeping there long enough to kill all living organisms) of the food and utensils used and the final exclusion of air by sealing the jar.

A common method of canning is the open kettle method in which the fruit or vegetable is cooked in an open kettle and then packed in jars and sealed. This method offers too many chances for troublesome bacteria to enter the food to be entirely satisfactory. For this reason the open kettle method has been replaced by more dependable ones.

*The One-period Cold-pack Method.**—This method of canning fruits, vegetables, meats, and fish has been adopted for use in the home canning-club work of the United States Department of Agriculture in the Northern and Western States. By *cold-pack* is meant that the uncooked cooled product is packed in hot jars and covered with hot liquid of

* According to a statement given out by the Bureau of Chemistry of the United States Department of Agriculture the danger of the food poisoning known as "Botulism" is eliminated by boiling the contents of the can for a few minutes before eating. The Bacillus Botulinus and the poison which it produces are destroyed by this treatment.

some kind. The jar is then partially sealed and placed in boiling water to cook.

By *one-period* is meant the cooking of the product a sufficient length of time to complete the process at one time. This method necessitates less handling of the jars and consumes less time than the method known as intermittent sterilization.

266. Steps in Canning.—There are six steps to be observed in the cold-pack method, as follows:

(1) *Preparation of Food Products and Utensils.*—The jars and covers should be washed, placed in cold water

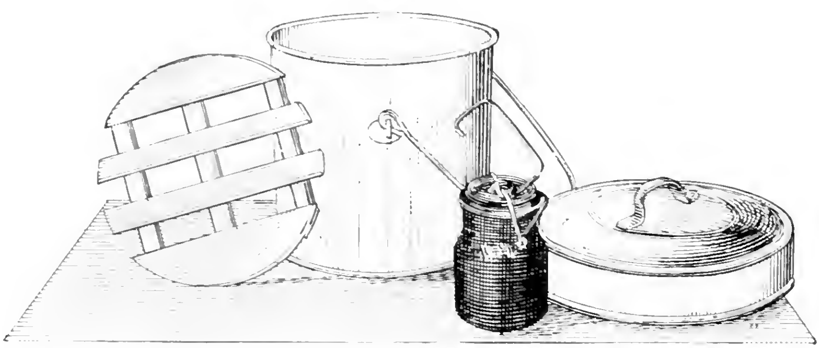


Fig. 37.—An improvised canning outfit.

and heated to the boiling-point. The foods should be washed and pared, pits or cores should be removed, and the foods should then be cut in pieces when too large to use whole. All products for canning must be clean, sound, fresh, and not overripe. It is especially important that vegetables for canning be fresh from the garden. Most vegetables lose crispness and flavor on standing.

(2) *Blanching or Scalding.*—The food materials should be placed in a colander, frying basket, or a piece of cheese cloth, and lowered into boiling water or live steam and kept there from one to fifteen minutes according to the kind of product. This process loosens the skin, takes out any excess of acid, and preserves the coloring matter in the food.

(3) *Cold Dip.*—The food material should then be taken from the boiling water or steam and plunged at once into cold water (the colder the better) for a few seconds and then drained.

(4) *Packing.*—The cold-dipped articles should be packed at once into the hot jars. The jar should be filled as completely as possible. If a vegetable, one teaspoonful of salt

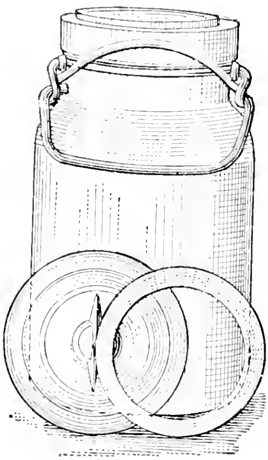


FIG. 38.—Unsealed jar.

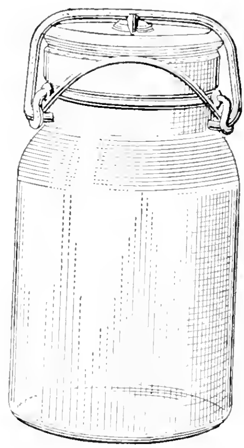


FIG. 39.—Jar ready for sterilizing.

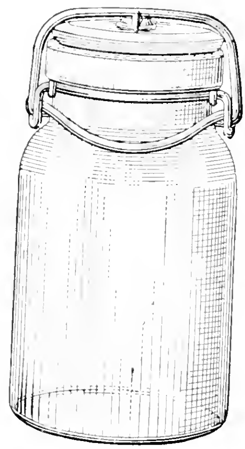


FIG. 40.—Jar completely sealed.

is added for each quart of material and the jar is filled with boiling water. In the case of fruit, boiling syrup takes the place of the water and salt. The scalded rubbers and tops of jars should now be put in place and the jar partly sealed.

(5) *Processing or Sterilizing.*—The partially sealed jars should be lowered into a water bath which completely covers the jars and boiled for the length of time specified in Table XII, for the particular kind of food.

(6) *Sealing.*—When the jars are removed from the hot water bath they should be entirely sealed and then inverted to cool. When sufficiently cool each one should be wrapped separately in paper and stored in a cool dry place.

267. The Intermittent Method of Sterilization.—By this method the food is sterilized in the hot water bath for

TABLE XII.—TIME FOR CANNING FRUITS AND VEGETABLES

(Bulletin U. S. Dept. Agr.)

Food Material.	Method of Preparation.	Time in Minutes.	
		Scalding or Blanching.	Sterilizing.
Berries:			
Blackberries, Blueberries, Gooseberries, Raspberries, Strawberries	Stem or hull, rinse in cold water, pack in hot jars	. . . .	16
Soft Fruits:			
Apricots	Peel	1–2	16
Cherries	Stone	. . . .	16
Currants	Stem	. . . .	16
Grapes	Seed	. . . .	16
Peaches	Peel and stone	1–2	16
Plums	Wash	. . . .	16
Hard Fruits:			
Apples	Peel, quarter and core	1½	20
Pears	Peel, cut in half, core	1½	20
Quinces	Peel, quarter	1½	20
Special Vegetables:			
Tomatoes	Remove skins	1½	22
Pumpkin	Peel and cut in pieces	3	120
Squash	Peel and cut in pieces	3	120
Sweet Corn	Remove husk and silk	5	180
Pod Vegetables:			
Beans, wax	Wash and string	5–10	120
Beans, green	Wash and string	5–10	120
Okra	Wash	5–10	120
Cauliflower	Soak in brine 1 hour	3	60
Root Vegetables:			
Carrots	Wash and scrape	5	90
Beets	Wash and scrape	5	90
Turnips	Peel and cut in pieces	5	90
Greens:			
Chard	Look over and wash	15 in live steam	120
Kale	Look over and wash	15 in live steam	120
Asparagus	Wash and scrape	15 in live steam	120
Spinach	Look over and wash	15 in live steam	120
Beet tops	Look over and wash	15 in live steam	120
Dandelion	Look over and wash	15 in live steam	120

a given period of time on three successive days. All spores that may have resisted the previous boiling processes are destroyed at the end of this period. This extra sterilizing is not always necessary but is considered a wise precaution.

268. The Use of Preservatives.—By preservatives is meant such substances as prevent or hinder the development of micro-organisms in food. They may be classed as *harmless, of doubtful safety*, and *harmful*. The harmless preservatives are sugar, salt, vinegar, and spice. Those about which there is some doubt are saltpeter and smoke. The use of harmful preservatives comes under the regulations of the Food Laws and will not be discussed here.

Sugar.—In a concentrated solution sugar will arrest the growth of bacteria. In dilute form with spices or vinegar it is also a valuable aid in restricting the growth of organisms.

Preserves and Conserves are mixtures of fruits, nuts and spices with a high percentage of sugar to make them rich and to control the growth of bacteria.

Jams and Marmalades are also rich, sweet compounds containing the juice and pulp of the fruit. They, like preserves, depend upon the fifty or more per cent of sugar to keep them from spoiling.

*Jelly.**—The jelly-making substance, pectin, is best obtained by cooking the fruit with water until the juice is freed from the pulp. Pectin, a substance closely related to starch in chemical composition, is an essential constituent

* The United States Bureau of Chemistry recommends the alcohol test to determine the amount of pectin present in a fruit juice and incidentally the amount of sugar required to make a perfect jelly. Put a spoonful of juice in a beaker and add to it a spoonful of 95 per cent grain alcohol. Shake gently and note the amount of pectin precipitated. If the precipitate forms in a mass, one cupful of sugar is required for each cupful of fruit juice. If the precipitate is broken up into several parts, one-half to three-fourths cupful of sugar for each cupful of juice is needed to form a perfect jelly. If the pectin is precipitated but not in a mass, the proportion of sugar required is one-half or less than the amount of juice used. Fruit juice that shows no precipitate in this test is lacking in pectin and will not make jelly unless combined with juices rich in pectin.

of fruit juice that is to be used for jelly making. The amount of sugar needed for a perfect jelly must be in proportion to the pectin in the juice. The time required for cooking depends upon the degree of concentration of the juice.

Salt and Vinegar are classed as preservatives chiefly because they protect food materials from the action of micro-organisms that cause decomposition.

Spices.—Some spices are slightly effective as preservatives, others are entirely lacking in power to prevent the decay of food. As condiments such materials stimulate digestion and, if used in large quantities, are harmful because of the danger of over stimulation of the digestive organs. Highly spiced foods are recommended for use in small quantities as condiments rather than for their food value.

268. Doubtful Preservatives.—*Saltpeter* is used in curing meats. It prevents the removal of color by the salt in the pickle. Because of its astringent action on foods, saltpeter is of doubtful value as a preservative.

Smoke owes its preservative qualities to the creosote it produces. It is sometimes used in curing beef, tongue, hams, and dried beef, because of the action of the creosote in arresting the growth of bacteria and also for the flavor it imparts to the meat.

269. Removal of Moisture or Drying.—When fruits or vegetables are cut in thin slices and spread out, they begin to lose moisture by evaporation. If a current of dry, warm air is constantly passed over them, the moisture will evaporate more quickly and the materials will soon become dry and crisp.

There are three methods by which the moisture of fruits and vegetables may be removed. The sun's rays will evaporate moisture rapidly. Many fruits and vegetables are successfully dried by this natural agent. Artificial heat removes moisture quickly and the heat of the stove has been utilized for drying purposes in the many patent driers

now on the market. One of these is shown in Fig. 42. The main object with all devices is to reduce the food substances to a dry leathery mass in a short time. In applying artificial heat it must be remembered that heat greater than

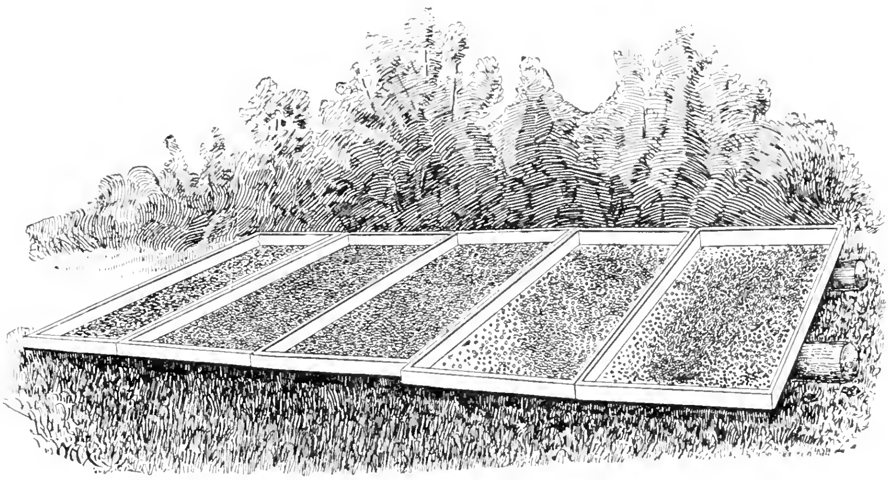


Fig. 41.—Sun drying.
(U. S. Dept. of Agri culture.)

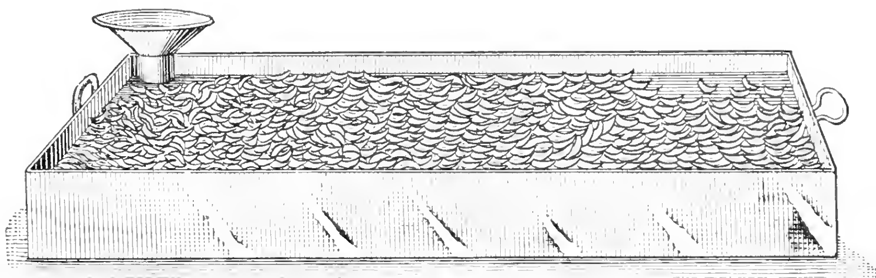


Fig. 42.—Drying by artificial heat.

150° F. is liable to scorch and brown the food, especially at the beginning of the process.

A current of dry air constantly passing over food will dry out the moisture in a comparatively short time. An electric fan makes an excellent drier at small cost.

270. Advantages in Drying Fruits and Vegetables.—By adopting some method of drying, the surplus of perishable

foods, which would otherwise be wasted, may be conserved. A considerable saving in the cost of food may often be effected in this way. Advantage may also be taken of an overstocked market and fruits and vegetables obtained in quantity at relatively low prices. When properly prepared, dried fruits and vegetables are acceptable substitutes when fresh varieties are out of season or scarce and high priced.

Drying may be adopted in place of canning, when jars are scarce. The dried products may frequently be stored in quantity in less space than would be required for jars or other containers.

271. Preparation of Foods for Drying.—Vegetables should be scrubbed clean, peeled or scraped, and sliced thin, or put through one of the various patent slicers or shredders, to make the pieces of uniform thickness so that they will dry evenly. Blanching is desirable for vegetables that have a strong flavor and odor, because it takes out some of the objectionable flavor and odor and also helps to soften the fiber. Fruits are prepared as for canning except that larger fruits should be cut in small pieces to facilitate the drying process.

272. Storing Dried Foods.—Food materials should be packed in tightly covered containers promptly after drying. Tin cans and glass jars may be used, but pasteboard receptacles with tight covers or even paper bags are protection enough for properly dried materials.

To test when foods are dry enough to store, place a crisp cracker in the container with the food and allow it to remain overnight. If the cracker is still crisp when removed in the morning, the product is without moisture.

SUGGESTIONS FOR LABORATORY PRACTICE

In connection with the study of the text of the preceding chapter:

Can fruits and vegetables in season by the one-period, cold-pack method.

Dry fruits and vegetables in season.

GLOSSARY

Absorption: The process of being absorbed or swallowed up.

Accelerate: To quicken, or hasten a process.

Acid: A substance capable of combining with a base to form a salt, and of turning blue litmus paper red. Sour to the taste.

Acidity: Sourness to the taste.

Acidosis: An abnormal body condition when acid is present in the tissues.

Acrid: Sharp or bitter to the taste; causing irritation.

Adjunct: Something joined to another thing without being a part of it.

Adulterate: To make a substance impure by mixing with it another substance of less value.

Aerate: To combine with gas.

Alkali: A caustic base which neutralizes acids and turns red litmus paper blue.

Amino Acids: A constituent of body protein.

Assimilation: Conversion of food into the substance of an animal or vegetable body.

Calorie: The unit of heat.

Carbonate: A compound formed by the union of carbonic acid with a base.

Cell: A tiny particle of matter consisting of protoplasm, in which floats a nucleus, surrounded by a cell wall.

Cellulose: The plant fiber which is an essential part of the wall membrane of plant cells.

Chlorophyl: The green coloring matter of plants.

Coagulate: To change from a fluid into a curd like or thickened mass.

Colloid: Semi-solid, non-crystallizable substance like glue or jelly.

Colloidal: Containing a colloid in solution.

Compound: A substance composed of two or more elements.

Dialyzable: Capable of diffusion through natural membranes.

Dietary: A fixed allowance of food; a rule of diet.

Dietetics: The science of diet; the study of food and nutrition in health and disease.

Diluent: Making thinner or weaker by admixture usually of water.

Disintegrate: To break up. To separate into parts.

Effervescence: The process by which gas is given off from a liquid.

Effete: Worn out with age.

Element: The simplest form of matter in which all atoms are alike.

Emulsion: A liquid full of tiny fat globules.

Enzyme: A group of substances found in plants and animals, which has the power of decomposing certain carbon compounds found associated with them.

Esophagus: The tube which takes the food from the mouth to the stomach.

Evaporate: To pass off in the form of vapor.

Ferment: A substance formed by the living cell and capable of acting chemically on food without any change taking place in itself.

Fermentation: A chemical change of organic substances by which they are decomposed and recombined into new compounds.

Fibrin: The form of protein found in coagulated blood.

Filter: To purify by passing through a porous substance.

Filtrate: The substance which has been filtered or purified.

Formula: A symbolic expression by letters or figures, of the chemical constituents of a compound.

Function: Appropriate action of a physical organ.

Inimical: Opposed to, unfriendly.

Inulin: A form of carbohydrate found in many plants; heated with water or dilute acid it is converted into lævulose.

Intermittent: Coming and going at intervals.

Lacteals: That part of the lymphatic system which carries the food from the intestines to the thoracic duct.

Liver: The largest gland in the body, lying immediately under the diaphragm. The cells of the liver separate certain substances from the blood and manufacture them into a dark green liquid called bile. The liver cells also act on certain parts of the food brought by the blood vessels from the intestines and hold some of it in storage.

Lymphatics: Small blood vessels which carry food from the intestines.

Microbe: A small living thing.

Micro-organism: A microscopic organism, as a bacillus.

Mucous Membrane: The lining membrane of the alimentary canal.

Nucleus: A differentiated round or oval body embedded in the protoplasm of a cell.

Nutrient: Something that nourishes.

Precipitate: A substance which separates in the solid state when two liquids are mixed.

PROTOPLASM: An albuminoid substance resembling white of egg, and capable of manifesting vital phenomena. The chief part of every cell.

PROTOPLASMIC: First formed as a constituent of organic bodies.

PTOMAINE: A poison developed in food by bacteria.

SATURATED SOLUTION: A solution which at a given temperature contains such a quantity of a substance that the two are in equilibrium, there being no tendency for more of the substance to pass into a solution.

SOLUBLE: Capable of being dissolved in a fluid.

SOLUTION: The conversion of a substance from the solid or gaseous state to the liquid state by treatment with a liquid.

SOLVENT: Any fluid or substance that dissolves or renders other bodies liquid.

STERILIZE: To render free from living germs.

PANCREAS: A gland situated in the abdomen near the stomach which pours its secretion into the small intestine.

PARASITE: An animal that lives on or in and at the expense of another animal. A plant which grows upon another plant or upon an animal and feeds upon its juices.

PERISTALSIS: The involuntary muscular movement of the alimentary canal whereby its contents are propelled forward.

TEMPERATURE: The degree of heat of a body.

TISSUES: An aggregation of cells and cell products.

VACUUM: An empty space.

VOLATILE OILS: Substances present in fruits, flowers, and some plants which give the characteristic odor and flavor.

INDEX

5M-7-1-18

ALTERNATING CURRENT ELECTRICITY AND ITS APPLICATION TO INDUSTRY. By W. H. TIMBIE, Head of Department of Applied Science, Wentworth Institute, and H. H. HIGBIE, Professor of Electrical Engineering, University of Michigan. **First Course.** x+534 pages, 5¼ by 8. 389 figures. Cloth, $2.00 *net.*

Second Course. ix+729 pages. 5¼ by 8. 357 figures. Cloth $3.00 *net.*

ELECTRIC LIGHTING. By H. H. HIGBIE, Professor of Electrical Engineering, University of Michigan. (*In preparation.*)

ESSENTIALS OF ALTERNATING CURRENTS. By W. H. TIMBIE and H. H. HIGBIE. (*In Press, Ready, Fall,* 1918.)

HEAT AND HEAT ENGINEERING

HEAT; A Text-book for Technical and Industrial Students. By J. A. RANDALL, Instructor in Mechanics and Heat, Pratt Institute. xiv+331 pages, 5¼ by 8. 80 figures. Cloth, $1.50 *net.*

GAS POWER. By C. F. HIRSHFELD, Professor of Power Engineering, Sibley College, Cornell University, and T. C. ULBRICHT, formerly Instructor, Department of Power Engineering, Cornell University. viii+198 pages, 5¼ by 8. 60 figures. Cloth, $1.25 *net.*

STEAM POWER. By C. F. HIRSHFELD, Formerly Professor of Power Engineering, Sibley College, Cornell University, and T. C. ULBRICHT, formerly Instructor, Department of Power Engineering. Cornell University. viii+419 pages, 5¼ by 8. 228 Figures. Cloth, $2.00 *net.*

HEAT AND LIGHT IN THE HOUSEHOLD. By W. G. WHITMAN, State Normal School, Salem, Mass. (*In preparation.*)

MECHANICS AND MATHEMATICS

ELEMENTARY PRACTICAL MECHANICS. By J. M. JAMESON, Girard College, formerly of Pratt Institute. xii+321 pages, 5 by 7¼. 212 figures. Cloth, $1.50 *net.*

MATHEMATICS FOR MACHINISTS. By R. W. BURNHAM, Instructor in Machine Work, Pratt Institute Evening School. vii+229 pages, 5 by 7. 175 figures. Cloth, $1.25 *net.*

PRACTICAL SHOP MECHANICS AND MATHEMATICS. By JAMES F. JOHNSON, Superintendent of the State Trade School, Bridgeport, Conn. viii+130 pages, 5 by 7. 81 figures. Cloth, $1.00 *net.*

PRINCIPLES OF MECHANISM. By WALTER H. JAMES, Assistant Professor of Mechanical Engineering Drawing, Massachusetts Institute of Technology, and MALCOLM C. MACKENZIE, Instructor in Mechanical Engineering, Massachusetts Institute of Technology. v+241 pages, 5¼ by 7½. 244 figures. Cloth, $1.50 *net.*

ARITHMETIC FOR CARPENTERS AND BUILDERS. By R. BURDETTE DALE, formerly Director in charge of Vocational Courses in Engineering and Correspondence Instruction, Iowa State College. ix+231 pages, 5 by 7. 109 figures. Cloth, $1.25 *net.*

SHOP TEXTS

MACHINE SHOP PRACTICE. By W. J. KAUP, Special Representative, Crucible Steel Company of America. ix+227 pages, 5¼ by 8. 163 figures. Cloth, $1.25 *net.*

PATTERN MAKING. By FREDERICK W. TURNER and DANIEL G. TOWN, Mechanic Arts High School, Boston. v+114 pages, 5 by 7. 88 figures. Cloth, $1.00 *net.*

PLAIN AND ORNAMENTAL FORGING. By ERNST SCHWARZKOPF. Instructor at Stuyvesant High School, New York City. x+267 pages, 5¼ by 8. Over 400 figures. Cloth, $1.50 *net.*

DRAFTING AND DESIGN

DECORATIVE DESIGN. A Text-Book of Practical Methods. By JOSEPH CUMMINGS CHASE, Instructor in Decorative Design at the College of the City of New York and at Cooper Union Woman's Art School. vi+73 pages. 8 by 10¾. 340 figures. Cloth, $1.50 *net.*

AGRICULTURAL DRAFTING. By CHARLES B. HOWE, M.E. viii+63 pages, 8 by 10¾. 45 figures, 26 plates. Cloth, $1.25 *net.*

ARCHITECTURAL DRAFTING. By A. B. GREENBERG, Stuyvesant Technical High School, New York, and CHARLES B. HOWE, Bushwick Evening High School, Brooklyn. viii+110 pages, 8 by 10¾. 53 figures, 12 plates. Cloth, $1.50 *net.*

MECHANICAL DRAFTING. By CHARLES B. HOWE, M.E., Bushwick Evening High School, Brooklyn. x+147 pages, 8 by 10¾. 165 figures, 38 plates. Cloth, $1.75 *net.*

ENGINEERING DRAFTING. By CHARLES B. HOWE, M.E. Bushwick Evening High School, Brooklyn, and SAMUEL J. BERARD, Sheffield Scientific School, Yale University. (*In preparation.*)

DRAWING FOR BUILDERS. By R. BURDETTE DALE, Director of Vocational Course, Iowa State College. v+166 pages, 8 by 10¾. 69 figures, 50 plates. Cloth, $1.50 *net.*

AGRICULTURE AND HORTICULTURE

FIELD AND LABORATORY STUDIES OF SOILS. By Professor A. G. McCALL, Ohio State University. viii+77 pages, 5 by 7. 32 figures. Cloth, 60 cents *net.*

FIELD AND LABORATORY STUDIES OF CROPS. By Professor A. G. McCALL, Ohio State University. viii+133 pages, 5 by 7. 54 figures. Cloth, 85 cents *net.*

SOILS. By Professor A. G. McCALL, Ohio State University. (*In preparation.*)

MARKET GARDENING. By Professor F. L. YEAW, Oasis Farm & Orchard Company, Roswell, New Mexico. Formerly Professor of Market Gardening, Massachusetts Agricultural College. vi+120 pages, 5 by 7. 36 figures. Cloth, 75 cents *net.*

THE CHEMISTRY OF FARM PRACTICE. By T. E. KEITT, Chemist of South Carolina Experiment Station, and Professor of of Soils, Clemson Agricultural College. xii+253 pages, 5¼ by 8. 81 figures. Cloth, $1.25 *net.*

STUDIES OF TREES. By J. J. LEVISON, Formerly Forester, Park Department, Brooklyn, N. Y. x+253 pages, 5¼ by 8. 156 half-tone illustrations. Cloth, $1.60 *net.*

AGRICULTURAL DRAFTING. By CHARLES B. HOWE, M.E. 46 pages, 8 by 10¾. 45 figures, 22 plates. Cloth, $1.25 *net.*

SCHOOL ENTOMOLOGY. For Secondary Schools and Agricultural Short Courses. By E. DWIGHT SANDERSON, Formerly Dean, College of Agriculture, West Virginia University, and L. M. PEAIRS, Professor of Entomology, West Virginia University. vii+356 pages, 6 by 9. 233 figures. Cloth, $1.50 *net.*

BIOLOGY

LABORATORY MANUAL IN GENERAL MICROBIOLOGY. Prepared by the Laboratory of Bacteriology, Hygiene and Pathology. Michigan Agricultural College. xvi+418 pages, $5\frac{1}{4}$ by 8. 73 figures. Several tables and charts. Cloth, $2.50 *net.*

COSTUME DESIGNING

COSTUME DESIGN AND ILLUSTRATION. By Ethel H. Traphagen, Instructor and Lecturer at Cooper Union, The New York Evening School of Industrial Art. ix+145 pages, 8 by $10\frac{3}{4}$. Upwards of 200 figures, including several in colors and a color spectrum chart. Cloth, $2.50 *net.*

PRINTING

PRINTING. A Textbook for Printers' Apprentices, Continuation Classes and for General Use in Schools. By Frank S. Henry, Instructor in Printing, Philadelphia Trades School. ix+318 pages. 153 figures. $5\frac{1}{4}$ by $7\frac{5}{8}$. Cloth, $1.25 *net.*

DOMESTIC SCIENCE

FOOD: ITS COMPOSITION AND PREPARATION. A Textbook for Classes in Household Science. By Mary D. Dowd and Jean D. Jameson, Teachers in Household Science, Washington Irving High School, New York City. vii+173 pages, $5\frac{1}{4}$ by 8. 42 figures. Cloth, $1.25 *net.*

A series of carefully selected exercises to accompany the texts of the Series, covering every subject in which laboratory or field work may be given. Each exercise is complete in itself, and is printed separately. 8 by $10\frac{1}{2}$.

Important Notice

WILEY LOOSELEAF MANUALS

The sale of separate sheets of the Laboratory Manuals of the Wiley Technical Series has been discontinued. These Manuals will, hereafter, be sold only as a complete book with removal leaves. Descriptive literature will be sent on request.

CHEMISTRY

Exercises in General Chemistry. By CHARLES M. ALLEN, Head of Department of Chemistry, Pratt Institute. An introductory course in Applied Chemistry, covering a year's laboratory work on the acid-forming and metallic elements and compounds. 62 pages, 8 by $10\frac{1}{2}$. 61 exercises. Complete in paper cover. Removal leaves. $1.00 *net.*

Quantitative Chemical Analysis. By CHARLES M. ALLEN, Head of Department of Chemistry, Pratt Institute. 12 pamphlets. 8 by $10\frac{1}{2}$. Complete in paper cover. Removal leaves. $1.00 *net.*

Qualitative Chemical Analysis. By C. E. BIVINS, Instructor in Qualitative Analysis, Pratt Institute. 11 pamphlets, supplemented by *Work Sheets* by which the student is taught equations and chemical processes. Complete with work sheets in paper cover. Removal leaves. $1.25 *net.*

Technical Chemical Analysis. By R. H. H. AUNGST, Instructor in Technical Chemistry, Pratt Institute. 19 pamphlets. 8 by $10\frac{1}{2}$. Complete. Removal leaves. $1.00 *net.*

Exercises in Industrial Chemistry. By Dr. ALLEN ROGERS, Instructor in Qualitative Analysis, Pratt Institute. (*In preparation.*)

MECHANICS AND HEAT

Exercises in Mechanics. By J. M. Jameson, Girard College; Formerly of Pratt Institute. 52 exercises. Complete in paper cover. Removal leaves. 85 cents *net.*

Exercises for the Applied Mechanics Laboratory. Steam; Strength of Materials; Gas Engines; and Hydraulics. By J. P. Kottcamp, M.E., Instructor in Steam and Strength of Materials, Pratt Institute. 8 by 10½. 58 exercises, with numerous cuts and tables. Complete in paper cover. Removal leaves. $1.00 *net.*

ELECTRICITY

Exercises in Heat and Light. By J. A. Randall, Instructor in Mechanics and Heat, Pratt Institute. 17 exercises, with numerous cuts and diagrams. 8 by 10½. Complete in paper cover. Removal leaves. 34 cents *net.*

Electrical Measurements, A. C. and D. C. By W. H. Timbie. Head of Department of Applied Science, Wentworth Institute 52 Exercises. Complete in paper cover, 85 cents *net.*

Elementary Electrical Testing. By Professor V. Karapetoff, Cornell University, Ithaca, N. Y. 25 exercises. Complete in paper cover. Removal leaves. 50 cents *net.*

Electrical Measurements in Testing. (*Direct* and *Alternating Current.*) By Chester L. Dawes, Instructor in Electrical Engineering, Harvard University. In charge of Industrial Electricity, Franklin Union, Boston. 39 Exercises. Complete in paper cover. Removal leaves. 75 cents *net.*

AGRICULTURE AND HORTICULTURE

Studies of Trees: Their Diseases and Care. By J. J. LEVISON, M.F., Lecturer on Ornamental and Shade Trees, Yale University Forest School, Forester to the Department of Parks, Brooklyn, N. Y. 20 pamphlets, 8 by 10½. $1.00 *net.* A cloth binder for above sold separately. 50 cents *net.*

Exercises in Farm Dairying. By Professor C. LARSEN, Department of Dairy Husbandry, South Dakota State College. Loose leaf. 8 by 10½. 69 Exercises. Complete. Removal leaves. $1.00 *net.*

DRAWING

AGRICULTURAL DRAFTING PROBLEMS. By CHARLES B. HOWE, M.E. A Manual for Students of Agriculture to Supplement the Text in Agricultural Drafting. 26 plates. 8 by 10½. In paper cover. Removal leaves. 50 cents *net.*

THE ORDERS OF ARCHITECTURE. By A. BENTON GREENBERG. A Manual for Students of Architecture to Supplement the Text in Architectural Drafting. 20 plates. 8 by 10½. In paper cover. Removal leaves. 50 cents *net.*